

THE TAY RAILWAY BRIDGE.

The new railway bridge over the river Tay was opened with much ceremony on the 31st May. The first movement to bridge the Tay was made about forty years ago by the Edinburgh and Northern (afterward the Edinburgh, Perth and Dundee) Company. It was not till 1871, however, that a project destined to be fulfilled was initiated. In 1870 the necessary Act of Parliament was obtained, and on the 8th of May of the following year the contract for the erection was signed. The contract was transferred in 1873 to Messrs. Hopkins, Gilkes & Co., of Middlesborough, and Mr. A. Grothe, who was engineer and manager to Mr. de Bergue, and had shown very great professional skill in the manner in which he proceeded to erect so gigantic a structure, was continued by the new contractors, and the admirable, thoroughly substantial bridge which now spans the river is a proof of their wisdom in taking Mr. Grothe into their service.

The bridge is 10,612 feet in length, or two miles and 52 feet, and is thus the longest railway bridge over a running stream in the world. The Victoria Bridge, Montreal, comes next in respect to length, being 9,194 feet, or 1,418 feet shorter than the Tay Bridge. A still more extraordinary bridge than either is one on the Mobile and Montgomery Railroad, called the Tensas and Mobile Bridge, which is fifteen miles in length, but as the greater part of it is carried over immense morasses, it cannot be fairly compared with the Tay Bridge, which spans a tidal river. The bridge starts from the Fife side of the Tay, where the land is about 70 feet above high water, and gradually rises at a gradient of 1 in 356 until the highest part of the bridge is reached, being 130 feet from the level of the rails to high-water mark. The greatest altitude occurs at the center of the large spans, and from this point toward the north side there is a sharply falling gradient of 1 in 74.

In the structure there are eighty-five spans of the following dimensions: eleven spans of 245 feet each, two spans of 227 feet each, one span of 166 feet, one span of 162 feet 10 inches, thirteen spans of 145 feet each, ten spans of 120 feet 8 inches each, eleven spans of 120 feet each, two spans of 87 feet each, twenty-four spans of 67 feet 6 inches each, three spans of 67 feet each, one span of 66 feet 8 inches, six spans of 28 feet 11 inches each. All the spans, with the exception of that of 166 feet, which is made by a bowstring girder, are formed of lattice girders. But, in addition to these spans, there are adjoining the north end of the bridge one span of 100 feet, bowstring girders, one span of 29 feet, plate girders. The thirteen largest girders, each being about 200 tons in weight, are in the center of the bridge, and over the navigable part of the river. The girders are arranged in continuous groups, with proper provision for expansion, and are all supported on piers of varied construction. The permanent way consists of double-headed steel rails, fished at the joints in 24 feet-lengths, weighing 75 lbs. to the yard, and secured by oak keys in cast-iron chains. The chains are fixed at intervals of about 3 feet to longitudinal timbers 17 inches wide, and varying in depth from 7 to 14 inches. Throughout the whole length of the bridge each rail is provided with a guard-rail to afford additional security to trains passing over the structure.

The floor of the bridge consists of 3-inch planking, and is covered with a water-proof composition. On both sides of the bridge, for its whole length, a strong hand-rail is erected, and painted in a light-blue color. The foundations of the piers are formed of iron cylinders, with brickwork and cement. Fourteen piers at the south side are built entirely of brick, and on rock foundation, and consist of two cylinders of 9 feet 6 inches in diameter, connected by a wall of brickwork 3 feet in width. At the fourteenth pier it was found that the rock suddenly shelved away to a great depth, under beds of clay, gravel, and sand, and therefore another kind of pier had to be resorted to which would

give an equally sure footing. The weight of the pier was lightened by substituting for the heavy brickwork above high water cast-iron columns, fixed together by horizontal and diagonal transverse bracing, and the cylinders were increased to 15 feet in diameter. The whole of the piers after the fourteenth are built in this manner, but in the case of the highest piers, supporting the 245 feet spans, they have a cylindrical base of iron and brick in cement 31 feet in diameter, and from 40 to 45 feet in depth, standing a few feet above high water. The whole of the cylinders supporting iron columns are finished with a coping of Carnyllie stone.

The first stone was laid on the Fifeshire side on the 22d July, 1871, and on September 25th, 1877, six years afterward, the directors and engineers had the satisfaction of crossing over the bridge for the first time in a train. The contract price of the bridge was £217,000, but the actual cost is £350,000, the great increase being caused because of the original plans of the piers having to be departed from, and plans prepared of another description of piers adapted to the soil in the bottom of the river. The quantities of materials used in the structure are as follows: 3,520 tons of cast iron, 6,281 tons of malleable iron, 90,600 cubic feet of timber, 8,600 of cement, 4,350,000 bricks, 27,000 cubic feet of dressed ashlar, and 355 cubic yards of rough ashlar. The engineers engaged in the construction of the bridge were Messrs. Alfred Grothe (superintending engineer), Frederick W. Reeves, G. G. Lawrence, R. S. Jones, Theodore D. Delprat, G. D. Delprat, and Thomas Templeton. On Mr. Grothe devolved the responsibility of carrying out the works, and he has done so with remarkable success.

LABOR IN SPAIN.

CONSUL DUFFLE, at Cadiz, reports business stagnation in that region. Mechanical laborers receive from 40 to 50 cents a day, according to aptitude; laborers on public works, 40 to 45 cents a day, and carpenters, blacksmiths, and masons 80 cents, and coopers and cellarmen in the wine districts as high as 95 cents a day.

THE RENHAYE ELEVATOR.

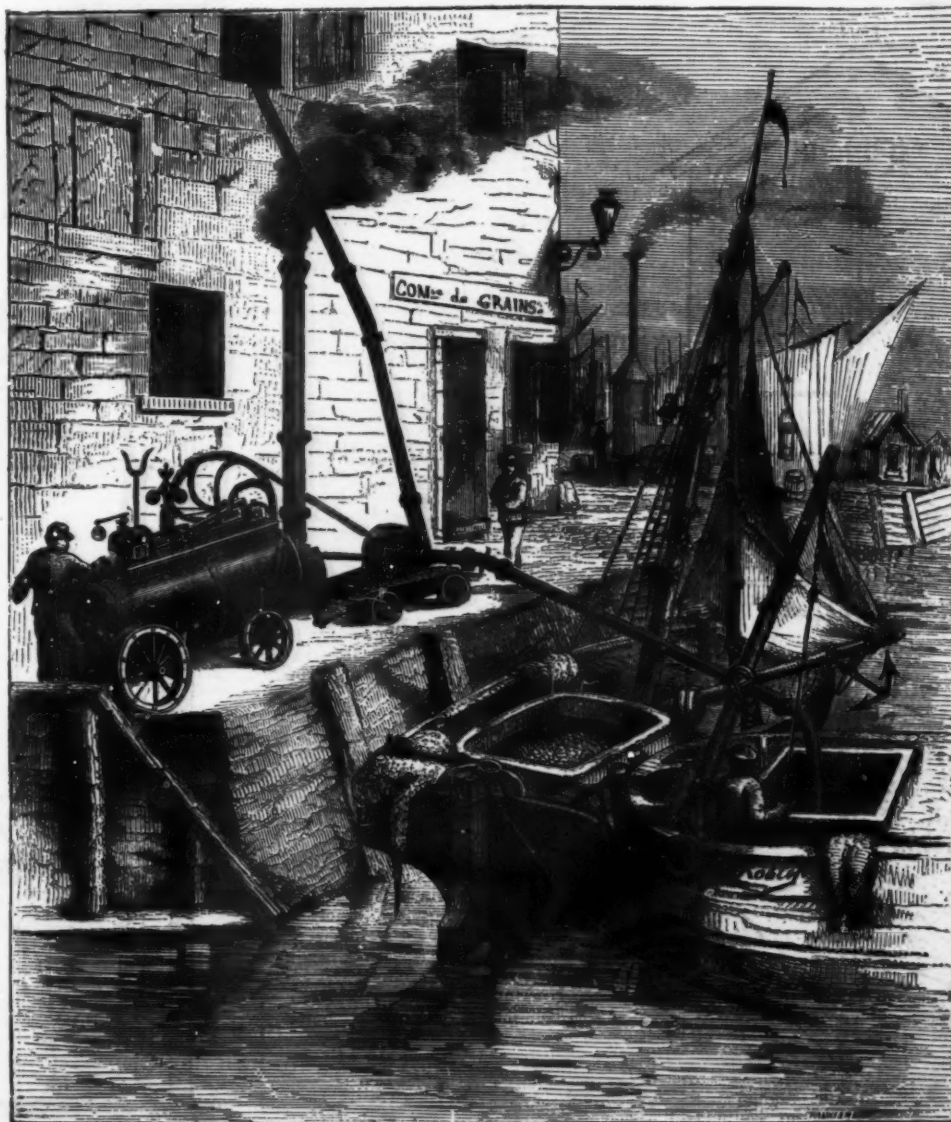
A new form of pneumatic elevator known as above has recently been constructed in France, by MM. Sauter and Lemonnier, and in the annexed engravings from *Revue Industrielle* it is represented in various arrangements. The principle on which it is based is that when divided solid matters are mixed with air in motion in a conduit a semi-fluid is formed, in which the pressures vary according to the laws of ordinary fluids. It may be demonstrated mathematically that in the semi-fluid column, pressures vary as in ordinary fluid; that the specific weight of the semi-fluid column may augment up to a certain limit; that the solids may be elevated to any height by regulating the specific weight of the semi-fluid according to the pressure obtained; that when the specific weight of the semi-fluid column is too considerable in proportion to the pressure, this column attains a limit in height which it cannot pass, and that the maximum results take place when the specific weight of the semi-fluid column is in the neighborhood of its maximum.

Barret and Korting have both utilized air pressure as a means of elevating grain, the one employing the vacuum produced by an air pump, the other entraining the air by a steam jet. The Renhaye elevator differs from both of these in that the air is set in motion by a fan blower or centrifugal ventilator, and that the specific weight of the semi-fluid is regulated by a pneumatic regulator. The construction of the apparatus will be understood from Fig. 1, page 2108.

V is a double ventilator capable of giving a pressure equivalent to 29.3 inches of water, connected to the receiver R by the tube T. Into receiver R the grain passes by the tube S, which is separated from tube T by a plane inclined at 45° which carries the grain to the lower part of the chamber. In the upper portion of the latter is a perforated partition which affords passage to the air and to dust. The grain escapes at the lower portion upon a platform placed at suitable distance to regulate the escape and hinder the re-entry of air. N is a regulator which governs the weight of the semi-fluid column according to the pressure. It consists of a piston the joint of which is a rubber membrane which extends without friction. A tube tt connects the tube S with the lower portion of the regulator. The piston is connected by pulleys pp', with a damper O, which comes down over the lower end of pipe S, and is designed to allow more or less air into the semi-fluid mass. This quantity of air is then by means of the piston regulated according to the pressure of the ventilator. It will be obvious that if the exhaustion of air in S reaches too high a degree, the upper part of N descends and O, is thus drawn up, increasing the air orifice at the bottom of the pipe.

MM. Sauter and Lemonnier have made numerous experiments on this device, of which the following are some of the results. The receiver was placed 22 feet above the ground. The motive power was 6 horse to elevate from 17,600 to 29,000 pounds per hour, and the regulator worked perfectly the instant the lower orifice of the pipe became choked. A large quantity of dust was mixed with the grain, but the latter was delivered perfectly clean, the impurities passing off through the aspirating pipe. By taking out the receiver and leading the grain through the ventilator the material was cleanly cracked without production of flour.

It was found that many important improvements could be applied to this apparatus. To secure the best results, it was deemed necessary that the velocity of the solids on arriving in the receiver should be nothing, and that the velocity of the air leaving the ventilator should have a determined value for each kind of grain. Fig. 2 shows the modification of the apparatus to this end. The rising tube is gradually increased in diameter so as to diminish progressively the velocity of the grain as it approaches the re-



IMPROVED PNEUMATIC GRAIN ELEVATOR.

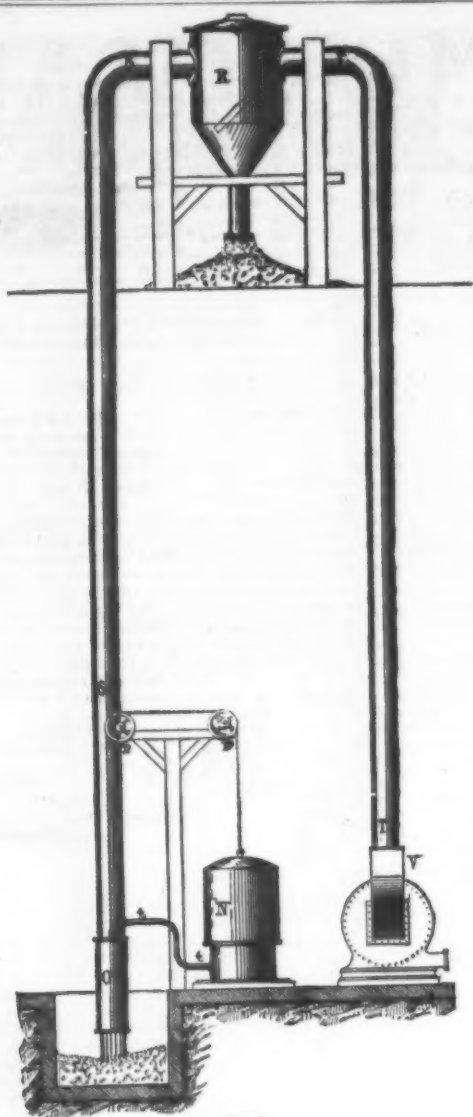


FIG. 1.

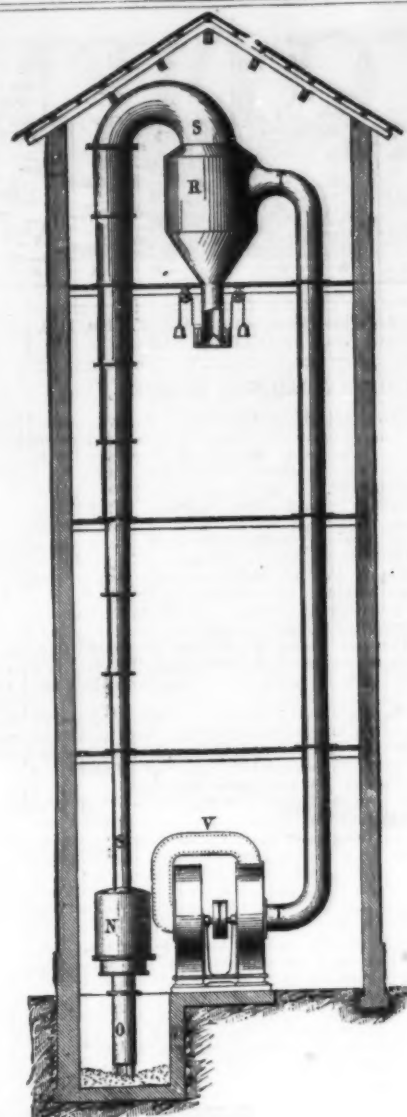


FIG. 2.

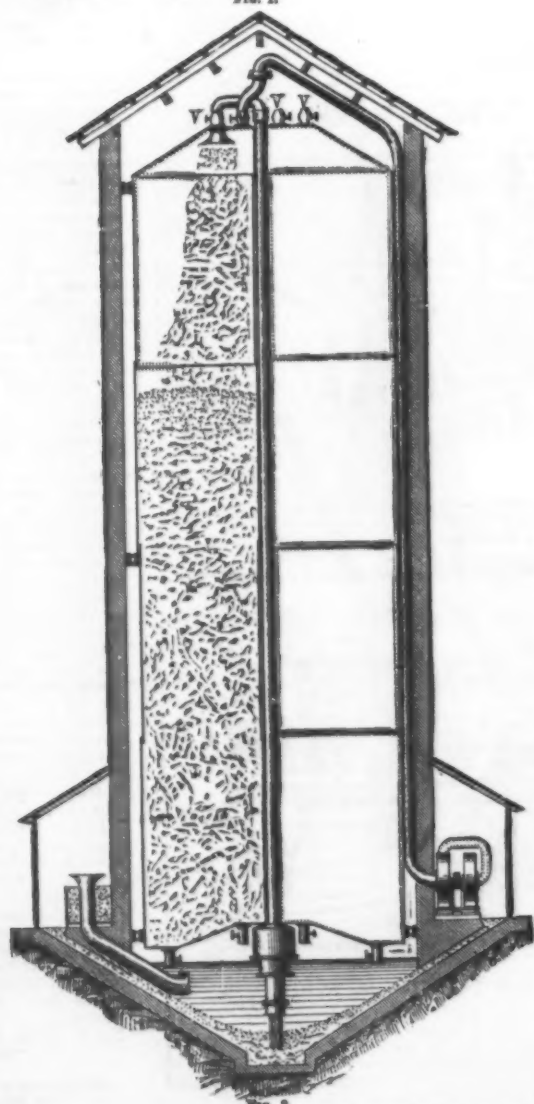


FIG. 3.

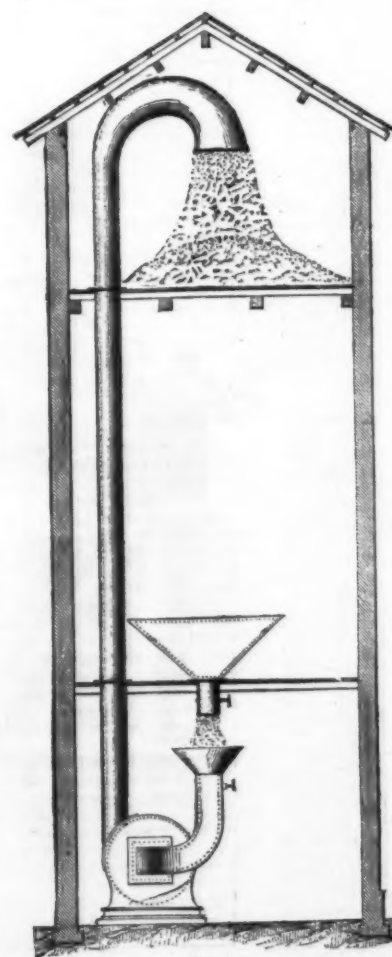
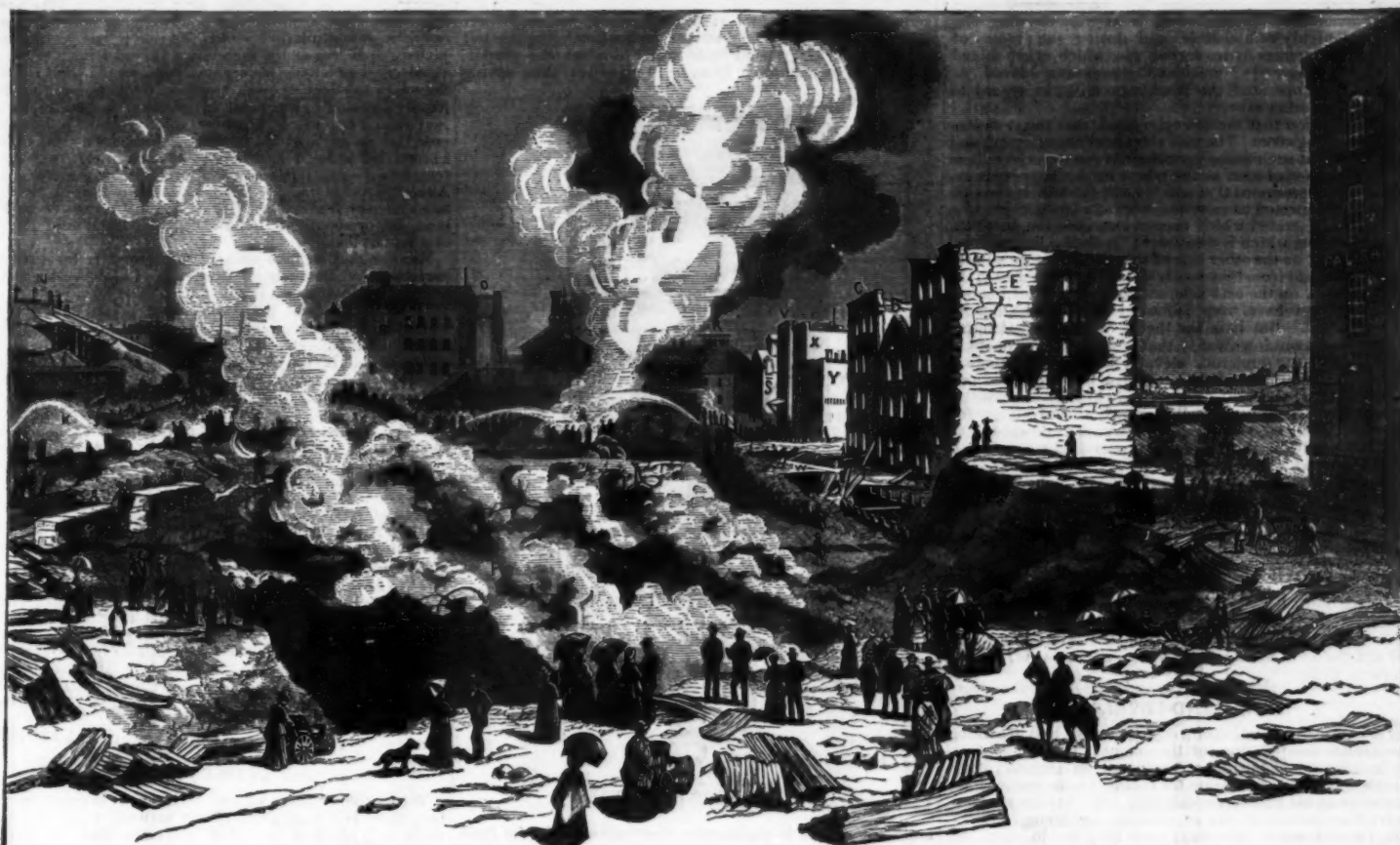


FIG. 4.

IMPROVED PNEUMATIC GRAIN ELEVATOR.



THE SCENE OF THE MINNEAPOLIS DISASTER.

A, Washburn Mill A; B, Washburn Mill B; C, Pettit, Robinson & Co.; D, Zenith; E, Galaxy; F, Guilder's Shop; G, Diamond Mill; H, Butler's Shop; J, Humboldt Mill; K, Planing Mill; L, Dry Shed; M, Palisade Mill; N, Round House; O, Anchor Mill; P, Elevator; R, Woolen Mills; S, Empire Mill; V, Pillsbury Mill; W, Covered Canal; X, New Morrison Mill; Y, Paper Mill.

ceiver. The latter is constructed so as to divide the air current by means of numerous concentric rings, and the orifice of the aspiration tube is enlarged so as to diminish the strangulation of the fluid vein. At the lower part of the escape tube is placed a conical counterweighted regulator. The regulator is placed around the rising tube and is in communication with the air passing from the ventilator, and hence modifies the velocity of the entrained air. This arrangement is said to give results far in advance of those reached by any other pneumatic system of elevation.

Fig. 3 represents another form of the device in which the grain is elevated, cleaned, ventilated and dried, all by the machine. When the bin is full it suffices to close the valves, V, to confine the grain in an atmosphere of carbonic acid and nitrogen which effectually prevents fermentation and the attacks of insects. In this case each bin serves as a separator. The air current coming from the nozzle of the ventilator is charged with dust and bad grains which are stopped by the resistance of the air according to their relative gravities. They thus become classified and may easily be collected in special receptacles.

Fig. 4 represents an elevator in which the grain is cracked. The grain is mixed with air in proper quantity by the aid of a butterfly valve, and after passing through the hopper it is broken up by the wings of the fan and then forced up to the desired height. The principal utilization of this system is in unloading vessels, and Fig. 5 represents a machine removing the grain from a vessel and delivering into bins in a building.

It has been determined by experiment that by giving the air a velocity of circulation of 64 feet per second, grain, plaster and similar substances can be elevated in a vertical tube; with a velocity of 128 feet stone in pieces large enough for macadamizing may be lifted; with a velocity of 192 feet heavy bodies, such as leaden balls, pieces of iron, etc., can be elevated. Large spikes, screw bolts, coke, coal and iron chain have been thus lifted without difficulty.

THE MINNEAPOLIS DISASTER.

At 7:20 p. m. Thursday, May 2, 1878, the city of Minneapolis, Minn., was suddenly shaken to its very foundations as if by an earthquake. The inhabitants of the city immediately rushed into the streets and saw the flames rising high in the air from the center of the milling district, and soon ascertained that there had been a terrible explosion—destroying eighteen lives and a vast amount of property. It was found that the explosion had occurred in the big Washburn mill, that it had been followed by the demolition of the Humboldt and Diamond mills situated in the rear thereof; that one wall and the roof of the Washburn "B" mill had been carried away, the solid stone wall carried from the side of the Galaxy mill, the Milwaukee & St. Paul Round-house more or less damaged, and the stone planing mill of Smith & Parker destroyed. The explosion was followed in less time than it takes to tell it by flames which enveloped the ruins of all the buildings, communicating to the mill of Pettit, Robinson & Co., the Zenith and Galaxy mills opposite, and threatened the entire milling district and the extensive lumber yards situated further down the river. The firemen spent all night in pouring incessant streams of water into the pile of debris which marks the scene of the disaster. Scarcely one stone stands upon another, as it was laid in the big Washburn mill, and the chaotic pile of huge limestone rocks is interwoven with splintered timbers, shafts, and broken machinery. The destruction of the Humboldt and Diamond mills is even more complete. The fire-seared walls of the Pettit, Zenith and Galaxy mills stand stark and burned, cleaned of their contents. The north wall of the Pettit mill is cracked and seared, and leans out from the plumb. The intense heat which prevailed will necessitate the rebuilding of every part of these mills. The platform which covers

the canal which runs between the Washburn "A" mill and the Pettit mill is torn and covered with debris. There is no vestige of the big elevator besides a huge pile of smoldering wheat. The machine shop of A. R. Guilder, a frame structure just back of the Washburn mill, was flattened as would have been the veriest wad of paper. The roof of a shed to the woolen mill is caved in. The Washburn "B" mill is jarred by the accident. The floors retain their place except in some places where they sag under the floor stored in the building. The stone planing mill adjoining the Humboldt mill is leveled, as were the planing mills, and no vestige of it remains save a pile of stones and broken machinery. The whole side of the Milwaukee and St. Paul Round-house, a frame structure, was taken out by the rebound of the explosion, and the roof has fallen. On the truck of the Minneapolis & St. Louis road stand the trucks and ironwork of twenty cars, but the woodwork and contents have been lapped so clean that ashes do not even tell of the fire.

The cars belonged to different companies, and the majority to freight lines. All the mills on the platform were badly shaken up by the shock, almost every light of glass being taken out of the Morrison, Crocker, Fish & Co.'s and Pillsbury's mills, and the mills on Sixth avenue south. Though the hot flames threatened to lick up in their mad fury the Palisade mill of L. Day & Son, it is the least injured of all the flouring mills. The shock did not damage the woolen mill beyond tearing glass and the sash from the windows. Everywhere about town can be seen the evidence of the terrific force of the explosion to which so many can testify. In Segelbaum's block, eight squares removed from the Washburn mill, two large plate glass windows were utterly destroyed. All down Washington avenue on both sides there is shattered glass in almost every store front. The plate glass windows in the Morrison Centennial block were nearly all broken. Not less than two thousand dollars' worth of glass was destroyed in buildings contiguous to the milling district. The lumber yard of Pettit, Robinson & Co. is a bleak and blackened waste.

In every part of the city are evidences of the explosion. A stone weighing fifty pounds was carried so that it fell on the roof of the Merriam block, eight squares from the Washburn mill. Another was carried and fell just in front of Brackett's block, six squares from the scene of the disaster. Huge pieces of timber were carried eight and ten blocks away, and the explosion was followed by a shower of missiles.

Washburn "A," or the "big mill," contained 41 run of stone. It had all the most modern and best improved appliances for the manufacture of the finest grades of flour. It was opened and operated by J. A. Christian & Co., and their brands of flour have earned a world-wide reputation.

The mill was of dual construction, two complete and independent mills under one roof. The building was 100x138 feet on the ground, with stone walls six feet thick at the base and eighteen inches on the top, and seven and one-half stories high, including the cupola. In each side of the sub-basement was a Boyden turbine water wheel, five feet in diameter.

The first floor was devoted to the machinery of the immense establishment, and on the second floor was the grinding room, with forty-one run of stones, each four and one-half feet in diameter. The third story was the packing room, and had eight packers, four on each side, which packed from 1,000 to 1,200 barrels of flour a day. The fourth and fifth stories were occupied by the bolting chests and the middlings purifying machines, sixty-five in number. In addition to these, there are two bran dusters on the fifth floor which brushed the flour from the bran as it passed through. On the sixth floor were the bolting chests for common grades of flour, and graders, cleaners and separators. The upper and seventh floor was one and a half stories high,

and contained the machinery which furnished the power to run all the other machinery in the mill excepting the stones. The most of the space in this story was taken up with bins for storing purified and unpurified middlings and cleaned wheat which extended to the floor below.

There were two main elevators, one on each side, capable of unloading two cars of wheat in fifteen minutes, carrying it to the upper story and emptying it into bins, and delivering it to other smaller elevators to convey it to bins out of reach of the main elevator.

The mill and office were both built of blue limestone hewn in uniform sized blocks with a rough surface, which gave the building a rich and beautiful appearance.

This mill ground from one and a half to two million bushels of wheat a year, discharging for wheat from \$1,500,000 to \$2,500,000 to the farmers and giving employment to over two hundred men the year round, including their coopers, as they had their own shops to manufacture their barrels.

The Humboldt mill, owned and operated by Bull, Newton & Co., was erected in 1875, had eight run of stone, and was valued at \$60,000. This mill had been thoroughly repaired and the most approved machinery placed in it during the past year, and was in fine running order.

The Diamond mill, owned by Gorton, Haywood & Co., was erected in 1875, had six run of stone, and was purchased by the present owners about six months since, for about \$35,000. Some \$10,000 had been expended in placing new machinery in the mill and was in excellent running order at the time of the accident. Valued by the proprietors at \$50,000.

The Galaxy mill was erected in 1874 by Ankeny & Brother, was burned on July 5, 1875, rebuilt in 1876, and leased to Messrs. Cahill & Co. in the fall of 1877. The Galaxy was one of the most complete mills on the falls, and was in perfect order at the time of the accident. Valued at \$85,000.

The Zenith, owned and operated by Day, Rollins & Co., was erected in 1871, and had six run of stone. The foundation had been laid for an addition in the rear, adding to the capacity six run, making it a twelve-run mill. Value of the mill about \$60,000.

The Pettit & Robinson mill was erected in 1876, had fifteen run of stone, and was the model mill of the city. No expense had been spared in the erection of the mill, and it was provided with the best modern machinery, and was valued at \$125,000.

The total loss is figured up to be \$824,160, and the total insurance \$523,600.

	Loss.	Insur.
W. P. Ankeny, Galaxy Mill.....	\$85,000	\$40,000
D. R. Barber & Son.....	2,000	3,500
S. S. Brown & Co.....	550	Unins.
Bull, Newton & Co., Humboldt Mill...	60,500	44,000
H. C. Butler.....	4,000	Unins.
Cahill, Ankeny & Co.....	12,000	9,000
J. A. Christian & Co.....	75,000	40,000
Crocker, Fisk & Co.....	9,380	14,000
Day, Rollins & Co., Zenith Mill.....	45,000	21,500
Goodrich & Co.....	2,750	2,750
Gorton, Haywood & Co.....	31,500	21,500
Hall & Dann.....	4,700	3,700
Minneapolis Mill Co., elevator.....	63,000	28,000
Minn. & St. L. R. R.....	2,800	2,800
Pettit, Robinson & Co.....	97,000	81,000
Smith, Parker & Co.....	3,500	1,550
Warner, Brewster & Co.....	500	Unins.
C. C. Washburn.....	300,000	175,000
W. D. Washburn, planing mill.....	7,500	4,250

Explosions in flour mills have been of frequent occurrence both in this country and in Europe. The cause of them has generally been attributed to the bringing of a spark or flame in contact with flour-dust mixed with air. Dust from flour,

bran, or even the smut and dust from grain-cleaning machinery, is highly combustible, and during the process of combustion generates hydro-carbon gas, which, when mixed with air, is possessed of great explosive power. Mr. J. A. Christian, who operated the Washburn mills, in regard to the recent explosion says:

It is his opinion that the fire originated from the stones in the east grinding-room. The mill was about changing off, and the stones are at such times permitted to run dry, the millers raising the stones as soon as the wheat in the hoppers is exhausted. It is presumed that some one of the millers through carelessness neglected to raise the stones in his charge; that friction was generated which communicated to the dust-box, the draught from which is downward. A similar fire occurred in the dust-box on the other side of the mill some two months ago. The draught from that box is up and not down, as in the case of the box on the east side, and an explosion of the box itself would not have been sufficient to create the disaster which followed. But it is the theory of Mr. Christian that the gas was drawn downward; that from the lower floors it passed through the numerous elevator ways and openings in all parts of the mill, filled the great structure, and was perhaps rarefied by the heat of the fire, which had grown in intensity, and which was finally ignited, the explosion following. It is his belief that the mill was shut down, as had been provided for in the rules which prevailed when the explosion occurred.

Verdict of the Coroner's Jury.—The substance of the verdict of the jury is as follows:

The disaster was the result of an explosion of mill dust floating in the air, kindled by fire in the wood work of the Washburn "A" mill, originating from a spark from a stone running empty. No evidence is found to show negligence on the part of the mill operatives, but the open purifiers in use in the mill are condemned as generating an unusual amount of dust.

The foregoing particulars are from the *Minneapolis Tribune* and the *U. S. Milling Journal*; our engraving is from the *American Miller*.

NEW HAND-LEVELS.

In deciding the situation of a country house, and in making approximate computations of the amount of grading necessary in the various positions considered, an architect finds that the requisite instruments for taking profile sections are not always at his immediate disposal. For overlooking extensive foundations in city or country, for laying out terraces, embankments, driveways, and the like, in short, for all cases where relative heights are to be determined, a level of some kind is necessary.

If the use of an approved Buff and Berger transit-level be

facile by the small screws, *m m*, the heads of which project sufficiently to stop the arm at that inclination. On the left side of the arc is a second scale which denotes the proportion of an embankment from 1:10 up to 1:7, thus saving

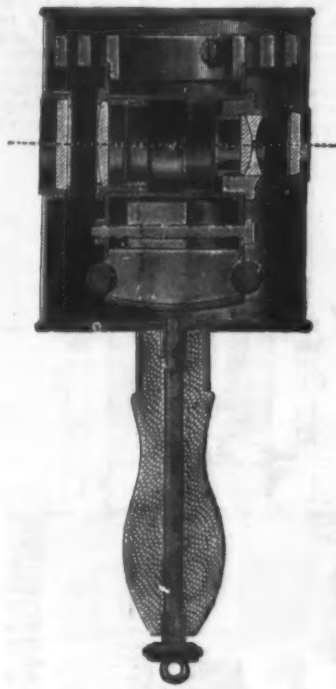


FIG. 4.—BOHNE'S LEVEL.

much calculation in preliminary observations. In the right end of the hollow prism, *a*, slides a cylindrical tube, *t*, which is closed at its outer extremity with a cap pierced with an opening for the eye, *n*. At the left end of *a* is a second hol-

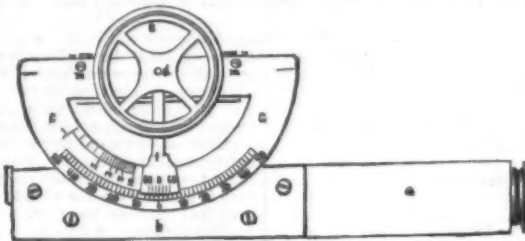


FIG. 1.—ABNEY'S LEVEL.—SIDE VIEW.

secured, an expensive purchase, even this will prove (according to the writer's recent experience) an unwieldy instrument for preliminary work. Its size and weight, and the loss of time and patience caused by the constant readjustment of the tripod and parallel-plates necessary at each new position, more than counterbalance the minute precision of the indication obtained. It seldom occurs that a variation of half an inch or so materially affects a decision. For rapid numerical comparison of heights the tripod level of any form

low prism, *A*, square and immovable, the upper half of the front opening of which is closed by the plate *t*. The line between the centers of the opening, *n*, and the lower edge of the plate, *t*, is the line of vision. The inner end of the prism, *A*, is cut at an angle of 45 degrees to this line, and bears the metallic reflector, *k*, the lower edge of which is exactly on the line, and is at the same time in a vertical plane with the axis, *d*. As is visible in the section, the upper side of the prism, *a*, is open over the reflector. The

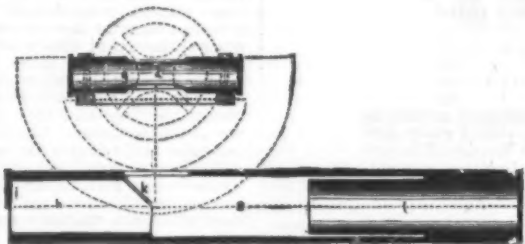


FIG. 2.—ABNEY'S LEVEL, IN SECTION.

is, for the prospecting surveyor, apparently supplanted by the application of an axis and arc to an ordinary hand-level. This application, which is practically an extension of the principles of Locke's level, was made by General Abney, and bears his name. As is to be seen from the side elevation and the section, Figs. 1 and 2, the sighting tube, *a*, is a square, hollow prism, to which is attached by four screws the plate, *b*, with the arc, *c*. The hand-wheel, *e*, turns around the axis, *d*, and with it moves the arm which bears the vernier,

holder of the spirit level, *g*, is open on the lower as well as the upper side, the center of the level itself being perpendicular to the plane in which lie the axis, *d*, and the 0 of the vernier. The use of the instrument is as follows: If the arm, *f*, is set at 0 on the arc, the level can be used to decide whether surfaces are truly horizontal by laying the prism upon them, or of lines by sighting. Should the arm rest against either of the screws, *m m*, the same will hold good for testing vertical surfaces.

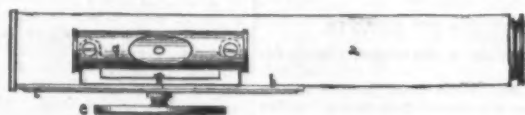


FIG. 3.—ABNEY'S LEVEL.—TOP VIEW.

f, and the spirit level, *g* (Fig. 2). The arc is divided into entire degrees, which extend from the horizontal 0 to 50 degrees inclination on each side. The vernier allows a reading of five minutes with the naked eye, but is more distinctly seen with a pocket magnifying glass. The lines on the arc on the level of the axis denote an angle of 90 degrees, and the fixing of this right angle, or vertical, is rendered more

If the left edge of the arm is placed against the figures on the inner side of the arc, the embankment, the proportion of which is thereon given, can be staked out. When used for leveling or finding relative heights, the instrument is held in one hand by the prism, *a*, or may be rested upon a staff. If the point is fixed, its vertical angle with the level of the eye can be found by cutting it in half with the lower edge of the

reflector and then turning the handwheel, *e*, until the bubble (see Fig. 3) is similarly bisected. After it has been thus adjusted the degree of the inclination is read from the arc and vernier. The bubble is very small and some little practice is necessary to effect its exact bisection while holding the level fixedly directed to the point in question; a greater inaccuracy than 5 minutes is, however, rare. When it is considered that an angle of 5 1/2 minutes represents a slant of only 1:1000 (100 x tg. 5' = 0.145), or an inch in eighty or ninety feet, it is seen that the cases of preliminary practice where Abney's level is inadmissible because of a lack of precision must be very few. The price of the instrument is, in England, £3, or about \$10, but a very small fraction of the cost of a transit-level.

Mention may be here made of a micrometer level recently perfected by Baumeister Böhne, of Charlottenburg, Germany. His instrument is automatic. The level is suspended by a universal joint (Cardano's swing), and works by its weight inside a tube, being arrested at will by a rod running through the handle. The micrometer is perpendicular to the level, and is seen magnified at the center, inside the little telescope. This is rendered possible in a very ingenious manner by making the eye-glass of two pieces similar to those which compose the well-known achromatic object-glasses. A plano-convex is joined to a double-concave lens, the center of the latter being pierced. Through the small opening thus provided the inner lens is seen focused upon the micrometer, while the eye at the same time receives the impression of the object viewed through the telescope. Short-sighted persons retain their glasses while using this level; if it is held with an unsupported hand the pulsations of the heart will affect it less if it be rested against the brow and cheek-bone, or a rod five feet long may be used as a rest. This instrument is admirably adapted for the uses for which it is intended, and by its distances and heights may be computed, as it possesses all the well-known advantages of a micrometer telescope. The price in Germany is 30 marks, or about \$7.50. The exterior tube is two inches high, with a diameter of an inch and a half (only). Its precision is as great as that of Abney's or any other hand-level; the field of vision embraces over twenty-two degrees, and its moderate price and small size are much in its favor.

ARCHITECT.

CEMENTS.

WHEN the surfaces of two bodies are brought into contact, there is always a film of air between them which prevents such absolute contact as will cause them to adhere together. This arises from the roughness and irregularity of the surfaces, but if they can be highly polished and rendered perfectly even and true, as is the case with small sheets of plate-glass, adhesion will take place if they are pressed tightly together, so as to exclude the air; and if such plates are kept under pressure for a considerable time, it will be found that they have become so firmly united as to be only separated by breaking. Ordinary building materials, as stone, wood, brick, etc., are, however, incapable of receiving this high degree of polish, and in order to make them adhere we must employ some viscous or semi-fluid substance which will attach itself firmly to each surface, and by hardening will unite the several blocks into one solid mass. Such substances are termed *cements*, and are of various characters, according to the nature of the substances to be united; thus, in order to unite stones or bricks the cement is such as can be mixed with water, the absorption and evaporation of which causes the cement to harden; but when pieces of wood have to be joined the cementing material is generally liquefied by means of heat, which hardens as soon as it becomes cold.

The term *cement* is, however, usually applied to those preparations which serve to unite stone and brick when employed in building walls, and under this head may be included ordinary mortar made with lime and sand; but, as we have before described the chemical nature and action of mortars under the head of "Limestones," we shall here confine our attention to those cements which harden or set quickly, either with or without the admixture of sand.

Selenitic Cement is so named from its containing a certain proportion of the mineral called *selenite* or *gypsum*, which is a hydrated sulphate of lime, as described under "Limestones." In the manufacture of this material any ordinary lime can be used, but that which is "hydraulic" produces the strongest cement.

Quick Lime is mixed with 5 per cent. of *dehydrated gypsum*, or that from which the water has been driven out; these materials, having been ground up together to a fine powder, are kept in a dry place ready for use. When 1 part of this powder is worked up with 5 or 6 parts of sharp sand and water, a quick setting cement is obtained for applying to the joints of brickwork or masonry; or it can be used as a stucco for the facing of rough walls. It must always be used fresh, as it becomes quite hard within 24 hours after being mixed with sand and water.

Gypsum is also a chief ingredient in another class of cements, used chiefly for internal decorations, finishing of walls and ceilings, etc.

Keene's Cement is made by mixing finely ground plaster of Paris, or calcined gypsum, with a solution of *alum*, which is a double sulphate of alumina and potash; it is afterward dried, re-baked, and reduced to powder. When used as a stucco it is mixed with a solution of alum, and will harden rapidly without any admixture of sand.

Martin's Cement consists of plaster of Paris treated in a similar manner, with a solution of the sulphate of potash or *pearlash*.

Parian Cement is also made in the same way as *Keene's*, but with the use of a solution of *borax*, the borate of soda, in place of alum. All these cements are capable of receiving a high degree of polish, and as they dry very rapidly can be painted over within a few days.

"Hydraulic" Cements.—Among the most important and most extensively used are the two called *Roman* and *Portland*, both of which are a mixture of lime and alumina, or clay, and have the valuable property of setting under water.

Roman Cement was so called by its original makers from a supposed resemblance to the old mortar or cement found in Roman walls, and was at first made only from certain argillaceous nodules called *septaria*, which were masses of clay and lime found imbedded in various parts of the geological formation called "London clay," more especially in the Isle of Sheppey, from which latter circumstance it was also called "Sheppey" cement. As, however, these nodules did not suffice to supply the great demand for this cement, an artificial imitation of their composition has been attempted by mixing 2 parts of chalk, or other limestone, with 1 part of a volcanic ash or clay termed *poszuolana*, chiefly obtained in the volcanic districts of Italy, the composition of which material is 45 per cent. of silica with 15 per cent. of alumina, 12 per

cent. iron oxide, 9 per cent. of lime, and 5 per cent. of magnesia, with small proportions of potash and soda. The limestone and pozzuolana are ground up together with water, then dried, calcined, and reduced to powder. On mixing this powder with water it hardens rapidly, and can be used either as a mortar for brick and stone, or as a stucco for covering walls. It is strongest as a cement when used "neat"—that is, without admixture of sand—but when employed as a stucco on walls, about 2 or 3 parts of clean sand can be mixed with it without detriment.

Portland Cement derives its name from its supposed resemblance to Portland stone when used as a stucco upon walls. The materials required in its manufacture are chalk, or any other "rich" limestone, river mud, or clay, and oxide of iron, the proportions in which these materials are mixed varying at different works—from 65 to 80 per cent. of limestone, and 20 to 35 per cent. of clay and iron oxide, which are intimately mixed with water in a mill, then dried slowly on hot plates, and afterward calcined in a kiln, and reduced to fine powder. Before being used the cement should be kept for some months in a dry place, as its cohesive strength is thereby increased. It hardens rapidly when stirred up with water, and possesses great cohesive power, which is diminished by the admixture of sand. When used as a stucco it can be mixed with 3 or 4 parts of sand to 1 of cement, and the setting then proceeds more slowly than if pure cement is used. The sand must be perfectly free from loamy particles, otherwise it will not harden, but will crumble to pieces at the touch. If painted over with oil color soon after it has been laid on a wall it will peel off and form blisters—probably from the large proportion of quick lime it contains not being thoroughly slaked before it hardened. Some months, therefore, should be allowed to elapse before paint is applied to it.

Mastic is a material that is classed among cements, being sometimes used for producing adhesion between two surfaces, but is more commonly applied in small quantities to external finishings and coatings of plaster, especially where the work has to be painted over immediately.

It is composed of finely-pounded brick or burnt clay, mixed in various proportions with limestone, sand, and the red oxide of lead called *litharge*, the whole being reduced to fine powder and mixed when required for use with linseed oil, on the evaporation of which it becomes very hard.

A **Mastic** for mending broken pieces of stone can be made with 20 parts of fine sand, 2 parts of litharge, and 1 part quicklime, mixed up into a thin putty with linseed oil. It takes, however, some considerable time to harden.

Water-glass is a material sometimes employed for uniting stones together, and for filling up cracks or fissures therein. It is a silicate of potash or soda, obtained by igniting fine sand or pounded flint with the hydrate of potash or soda, in the proportion of 1 part silica to 2 parts of the alkali, the result being a transparent glass which is readily soluble in boiling water, and slowly in cold water. It may also be obtained in a liquid state by boiling flints in a solution of caustic soda. If the *water-glass* is mixed with slaked lime it sets rapidly, and gradually hardens into a double silicate of lime and alkali, on which water has no solvent power. When used for cementing a limestone or dolomite, it also forms a double silicate with the lime or magnesia in the stone, and unites the whole into a compact mass.

Artificial Stone.—This material is also used for producing a kind of artificial stone by mixing the solution with pulverized stone and ramming it into moulds of the shape required. When this is sufficiently hard it is turned out of the moulds and saturated with a solution of the chloride of calcium obtained by treating limestone with hydrochloric acid. A chemical decomposition now occurs by the soda of the silicate changing place with the lime of the chloride, so as to produce the insoluble silicate of lime within the mass so as to hold the particles of stone firmly together, while the chloride of sodium, or common salt, is deposited on the outer surface, and can readily be removed by washing with water.

Malm Stone.—A similar kind of artificial stone can be also obtained without the use of chloride of calcium, and subsequent necessity for washing to remove salt, by means of a peculiar sandstone called "Malm Rock," found in the upper greensand formation, of which the composition is 81½ per cent. of silica, with 15 per cent. of alumina, the great peculiarity being that about one-half of the silica in this stone is soluble. This material is mixed in a powdered form with a solution of silicate of soda or potash, lime, sand, and alumina, then poured into moulds and hardened into a compact mass by the formation of silicate of lime; the silicate of soda being decomposed, and the soda uniting with the soluble silica of the stone, a fresh quantity of silicate of soda is produced to be again decomposed by contact with the lime, until all the soda becomes fixed in the mass, and there is none deposited on the surface requiring to be removed by washing.

Sal Ammoniac Cement.—For uniting pieces of iron, a cement can be made by mixing finely-pounded iron borings with about 1 per cent. of *sal ammoniac* made into a paste with water. The oxidizing of the iron powder causes it to expand and solidify so as to unite the surfaces together.

Red Lead made into a paste with boiled linseed oil is also used for cementing the joints of metal pipes.

Shellac Cement.—When the gum called *shellac* is dissolved in alcohol or naphtha, a cement for uniting broken glass, china, or stoneware is obtained.

Glue is a cement used for joining pieces of wood together, and has for its chief constituent a substance called *gelatine*, obtained from the cuttings of hides, skins, tendons, and other refuse parts of animals, as well as from cuttings of leather, and parchment, which, after being well soaked in milk of lime, to dissolve any blood, flesh, or fat, are thoroughly washed in a stream of water to remove the lime. The material is then boiled in water until the required adhesive strength is obtained, when the liquid is run off into a cistern and clarified with powdered alum, which precipitates in the form of sulphate any lime that may remain, as well as other impurities. Before cooling it is drawn off into moulds, and is then in the form of *size*, which, when cut into slices and dried in the air, hardens into *glue*.

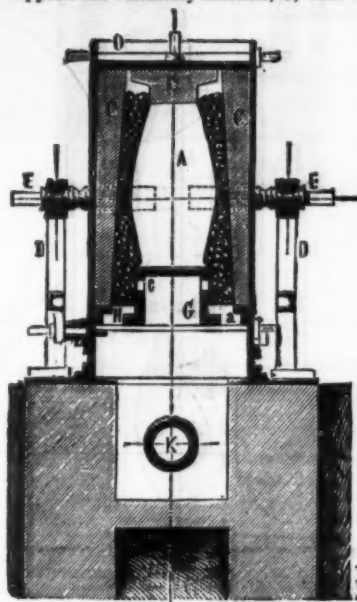
Insoluble Glue.—This is easily dissolved in water, but can be rendered insoluble, if required, by mixing 8 parts of melted glue with 4 parts of linseed oil which has been boiled into a varnish with litharge. This *insoluble glue* can be used for the joints of wooden cisterns or casks, which it renders watertight.

Veneice Cement.—If glue is mixed with one-fourth its weight of Venice turpentine, a cement is formed which will unite glass with metals or wood.—*Building News*.

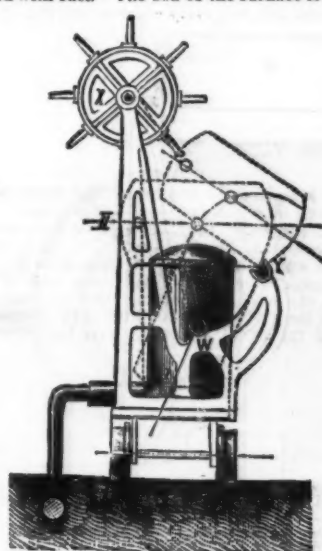
GERMAN PATENTS.—The German Patent Office received 6,24 applications for patents during the past year, a greater number than was applied for in any other country except the United States.

PORTABLE CRUCIBLE FURNACE.

THIS furnace, which has been patented by M. Albert Plat, of Paris, is built with the object of melting metals in a crucible and permitting the crucible full of melted metal to be brought, together with the furnace, to the place where the casting is to be made. The casting is made direct from the crucible, which, up to the moment of casting, retains its original position in the furnace. The delays that are at no time so dangerous as when melted metal is being handed about are thus minimized. In the accompanying sketch, A is the crucible, placed in an upright shaft of square section forming the body of the furnace. An iron envelope on the outside supports the refractory material, C, with which the



furnace is lined. The furnace is swung at E upon the bearings of the blocks, D, at such a height that the horizontal axis of gravity lies but very little below the axis of support when the crucible is filled with melted metal. A rod keeps the furnace temporarily fixed in its place. The shaft of the furnace is stopped by a covering of fireclay, H, which has an opening, over which is placed the cast-iron cap, G, in the sides of which are drilled several holes. The sides of the envelope are rounded off above and below to the curve described round a point in the center of the axis, E. An air-chamber communicates through the furnace bed with the air-inlet, K. The space between the fireclay and the crucible is filled with fuel. The bed of the furnace is bored with



four holes, and the foot, F, is bored in four places to correspond. If the fire is meant to burn with a natural draught the upper part of the furnace is connected with the chimney, and the openings in the cover are carefully closed. The pins on which the furnace turns are prolonged in a four-square form to admit of the fitting of a key with which a rotary motion is given to the furnace. Together with its bed the furnace can be placed on a trolley and hung up in a proper framework. By means of a chain and windlass, X, the furnace is rotated on the axis, Y; when the furnace is brought into position II, the axis, Y, comes into use and assists in regulating the flow of the metal. Beyond the ease with which this furnace can be manipulated, it possesses, as before mentioned, the great advantage that the molten metal is preserved from the action of the outer air. Better castings are thus got, and less metal is lost.—*Iron*.

A LECTURE ON EXPLOSIVE AGENTS.

DR. CARNELLY, of Owens College, Manchester, lately delivered a lecture, under the auspices of the North Staffordshire Institute of Mining and Mechanical Engineers, on "Explosive Agents Bearing on Colliery Explosions," at the Town Hall, Stoke-upon-Trent.

Dr. Carnelly said that previous to the discovery of the fulminating compounds of mercury, silver, and gold in the early part of this century, their knowledge and use of explosive agents were limited to gunpowder, or to mixtures having a very similar composition, but the rapid advances which had been made by science during the last fifty years had had considerable influence on the use of explosive agents, especially as regarded the fulminates gun-cotton, nitroglycerine, and picric acid, all of which powerful explosives were the result of scientific research. The importance of

considering the subject of explosive agents from a mining point of view was shown by the extent to which these bodies were now used for mining purposes, nine-tenths of all the explosives made, including common gunpowder, being used for blasting in mining and engineering operations. One of the chief points to which he wished to direct their attention was the conditions under which the explosion of the most important explosives took place. Another important thing in connection with the subject was the bearing which the use of explosive agents for blasting had on colliery explosions. Leaving out gaseous explosives, he might say that explosives were the solids and liquids which could be made to assume suddenly the gaseous state. The relative volume of the gas thus formed depended in the first instance on the total or partial gasification of the explosive, and in the second place on the degree of the temperature imparted to the same. An increase of every 273° Centigrade would effect an expansion in the volume equal to the total amount of the evolved gas when measured at 0° Centigrade. Hence it was quite the same, as regarded the pressure of the explosion, whether an explosion evolved a greater amount of gas and less heat, or proportionately a smaller amount of gas and more heat. The force of an explosion depended, first, on the volume of gas produced, and this was greater, *ceteris paribus*, the greater the quantity of explosive converted into gas. This was one reason why the power of nitroglycerine and gun-cotton was so much greater than that of gunpowder, for in the latter case a considerable quantity of residue was left, whereas with nitroglycerine no ash remained, all the products of the explosion being gaseous. Supposing there was no increase in temperature, 1 volume of nitroglycerine yielded 1,259 volumes of gas, while 1 volume of gunpowder, on the average, yielded 280 volumes of gas. The second point on which the power of an explosive depended was the temperature produced by the explosion, for the greater this was the greater, *ceteris paribus*, would be the volume of the gas produced at the moment of explosion, and consequently the greater the rending force. In that respect the more recent explosives were superior to gunpowder. A very important circumstance which influenced the power of an explosive was the suddenness with which the explosion took place, for the more sudden the explosion the greater the force developed. This depended in a great measure on the speed with which the ignition spread through the mass of the powder, which in turn depended on its chemical and mechanical condition, and also on the method of firing. Having explained the chemical nature of explosive agents, he said gun-cotton might be made to burn very slowly, and almost without flame. It burnt with great rapidity, but without explosion, when simply ignited by the flame of a lamp. He showed a small cake of compressed gun-cotton into which a hole had been bored by a red-hot poker without any explosion. The same cake would, when fired by a fuse of fulminate of mercury, be sufficient to convert the Town Hall into a heap of ruins. Gun-cotton might, when burnt in a confined space or under conditions depending on the mode of firing and its mechanical condition, be made to explode with terrific violence. Other explosive bodies were similarly influenced. A charge of gunpowder in a cylindrical tin case fired by a fuse inserted near the bottom exploded much more violently than the same charge ignited by a fuse placed just beneath the surface. Chloride of nitrogen, unless confined, exploded with comparatively little violence. Nitroglycerine, which resembled chloride of nitrogen in the suddenness of its explosion, did not explode when a naked light was applied to it for a short time, but required the fulfillment of special conditions for the development of its explosive force. It was not necessary for the substance to be confined in order to develop its explosive power. This result was readily obtainable by exposing the substance to the action of the detonation produced by the ignition of a small quantity of fulminating mercury closely confined and in close proximity to the nitroglycerine. It also exploded by percussion or in contact with red-hot iron, but not when a piece of red-hot copper or a burning coal was thrust into it, provided it were not confined. He explained that dynamite, a mixture of nitroglycerine with various other substances, if made with quartz sand, possessed greater rending power than when prepared with a more yielding material. He then gave illustrations of the explosive effects produced by ignition, percussion, and detonation. As a rule, he said, explosions of one and the same substance by percussion were far more violent than those produced by simple ignition, while those produced by detonation were the most violent of all, the difference being owing to the speed with which the explosion took place throughout the whole mass. In the case of firing gunpowder by ignition the explosion spread comparatively slowly from particle to particle, while when fired by detonation the explosion took place almost instantaneously throughout the charge. Charges of gun-cotton contained in blast-holes, and having a detonating fuse inserted in or immediately over them, had produced much greater rending and shattering effects in hard rocks (although the blast-holes were left entirely open) than similar charges with common fuses, although in the latter case the gun-cotton was confined by a tamping.

PAINT AS A PRESERVATIVE.

To the Editor of the Scientific American:

In examining the uncompleted central spire of the ancient cathedral at Rouen, in France, I was surprised to find that the material (cast iron, bolted together) was entirely covered with thick rust, and in some places the oxide would flake off in pieces weighing a quarter of an ounce. This magnificent spire is one of the highest architectural points in the world, entirely composed of cast-iron open work in the floriated Gothic style. So far there have been \$150,000 expended on it, and a like sum is required to be raised by private subscriptions and by petty admission fees to complete it with its bells, after which it is to be painted. The rapid corrosion of the general surface is, of course, to be deplored, but that in the flanged joints, where oxidation is most thorough and deep-reaching, proves a positive source of danger. The nuts are round-headed, and the wrench-holes therein rapidly filling up with rust, while the cementing of their under faces to the surface of the flanges will evidently render tightening up a difficult and expensive job.

Corrosion has now got so well started that it will be almost impossible to arrest it even with thorough scraping and painting, as the peculiar nature of the chemical action is such that a film of rust, so far from being a protection against oxidation below it, actually hastens it, as witness also the rapid destruction of boiler plates when once they commence to go. It is to be hoped that the magnificent monument at Rouen will not fall a sacrifice to ignorance or procrastination.

Paris, June 1, 1878.

ROBERT GRIMSHAW.

BRASS WIND INSTRUMENTS AS RESONATORS.

At a recent meeting of the London Physical Society, Mr. D. J. Blaikley read a paper on "Brass Wind Instruments as Resonators," describing an attempt he has made to carry into some detail certain acoustical investigations of the late Sir C. Wheatstone, who proved experimentally that a complete cone gave resonance to the same notes as an open cylindrical tube of equal length. A method by which the positions of the nodal points in a cone and in a bugle had been fixed was shown, and attention was drawn to the fact that the position of the center of magnitude of any closed conical tube was at the same distance from the open end as the center of magnitude of a closed cylindrical tube of the same pitch. It was then shown that a complete cone cannot be used by the lips as a wind instrument, that conic frustra cannot give resonance to the same series of notes as complete cones, and that, therefore, the conical form must be modified, and as this modification of form makes the position of a node for every note required more or less coincide with that of the lips, so will the instrument be more or less perfectly in tune. As the number of quarter wave-lengths in a cone or wind instrument is not directly proportional to the vibrational number of the note, as it is in free space or in an open tube, so the velocity of the wave of a given note is not exactly the same as that of another note of different pitch. Experiments were shown to illustrate the effect of varieties of form in producing different qualities of tone, and evidence was given of the existence of very high harmonic or partial tones in the low notes of wind instruments. In the trombone the ninth partial tone (three octaves and a tone above its prime) was thus proved to be sounding, and partial tones up to the sixteenth have been heard. In conclusion, a summary was given of the partial tones sounding in the tones of different instruments, and attention was drawn to the chief differences in form which influence quality of tone.

Sir W. Thomson pointed out the connection between the range of a musical instrument and the phenomena observed in a trumpet-shaped bay between high and low water; and he considered that an investigation of the overtones due to the cavity of the mouth would well repay research in explaining the influence its shape has on the vowel sounds.

Lord Rayleigh observed that in a conical musical instrument the correction to be made on account of the cone not being perfect to the apex is equal to six-tenths of the radius of the open end, and he pointed out that with a bell-mouthed instrument much of the sound is diffused as spherical waves.

Dr. Guthrie placed on the table a communication on salt solutions and attached water, and on the separation of water from crystalline solids in currents of dry air, in continuation of his researches, which have already been published. The results could not be usefully abstracted, but as an instance of the important results obtained it may be mentioned that Dr. Guthrie finds that when dry air is passed over chloride of barium at a temperature just above 25° C. the β -molecule of water is given off, and that the α -molecule of water is only separated at a temperature just above 60° C. In studying the effect of media other than water in the solution of salts, he finds, for instance, that two solutions of cobalt of equal strength differ greatly as to color if they are formed with water and glycerine. He has also traced the influence

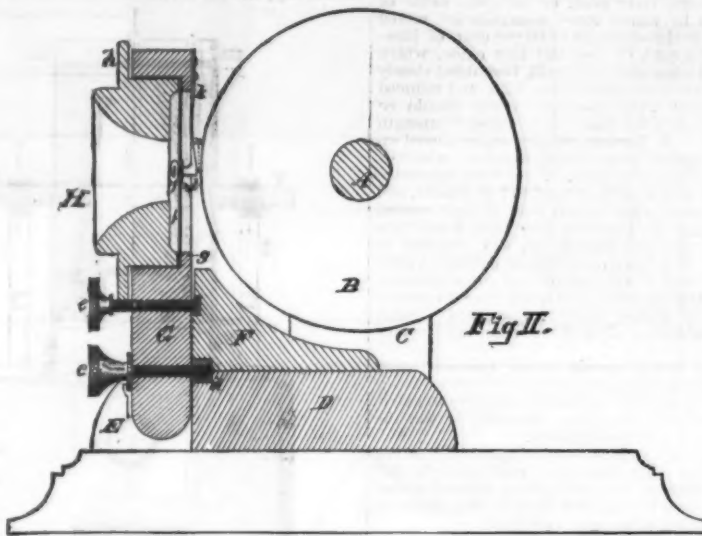
not absorbed by speculum metal, and we have as yet no idea of the lower limit of the waves of heat.

Sir W. Thomson, in continuation of the communication made to the Society at its last meeting, described the effect of torsion on the electric conductivity of a tube of brass. He showed that the effects of pull and thrust were different, and in the case of a tube, as in the case of a plate, there is a diminution in conductivity in the direction of pull; in the case of the tube, however, the components of the forces result in a sort of echelon arrangement as regards conductivity. The experimental part of the work was conducted by fixing the tube to a collar of brass which was attached to

be 16 to the inch, and the form of the thread should be square.

The shaft, A, is journaled in wooden standards, C, which are 1x1½ in. in transverse section. The distance from the base piece to the center of the shaft is 3¼ inches. The base piece is 7x11½ inches face and 1 inch thick.

The standards may each be secured to the base by two common wood-screws. The distance between the standards is twice the length of the cylinder, or 8 inches. A steel plate, a, is fitted to the groove of the screw threads in the shaft, and is secured to the side of the standard, which is slightly beveled to conform to the pitch of the screw.



a stand, the tube being arranged in a horizontal position. A magnetometer bearing a mirror could be placed inside the tube, and the changes in its conductivity produced by torsion were rendered evident by a reflected beam of light. The effects were also investigated by placing a core of soft iron in the tube, a balanced magnetometer being arranged outside the tube, near one end of the soft iron. Any changes in the conductivity of the tube induced by torsion were rendered evident by the changes in the amount of magnetism induced in the soft iron as indicated by the magnetometer.

HOW TO BUILD A WORKING PHONOGRAPH.

WITH DRAWINGS MADE TO A SCALE OF HALF SIZE.

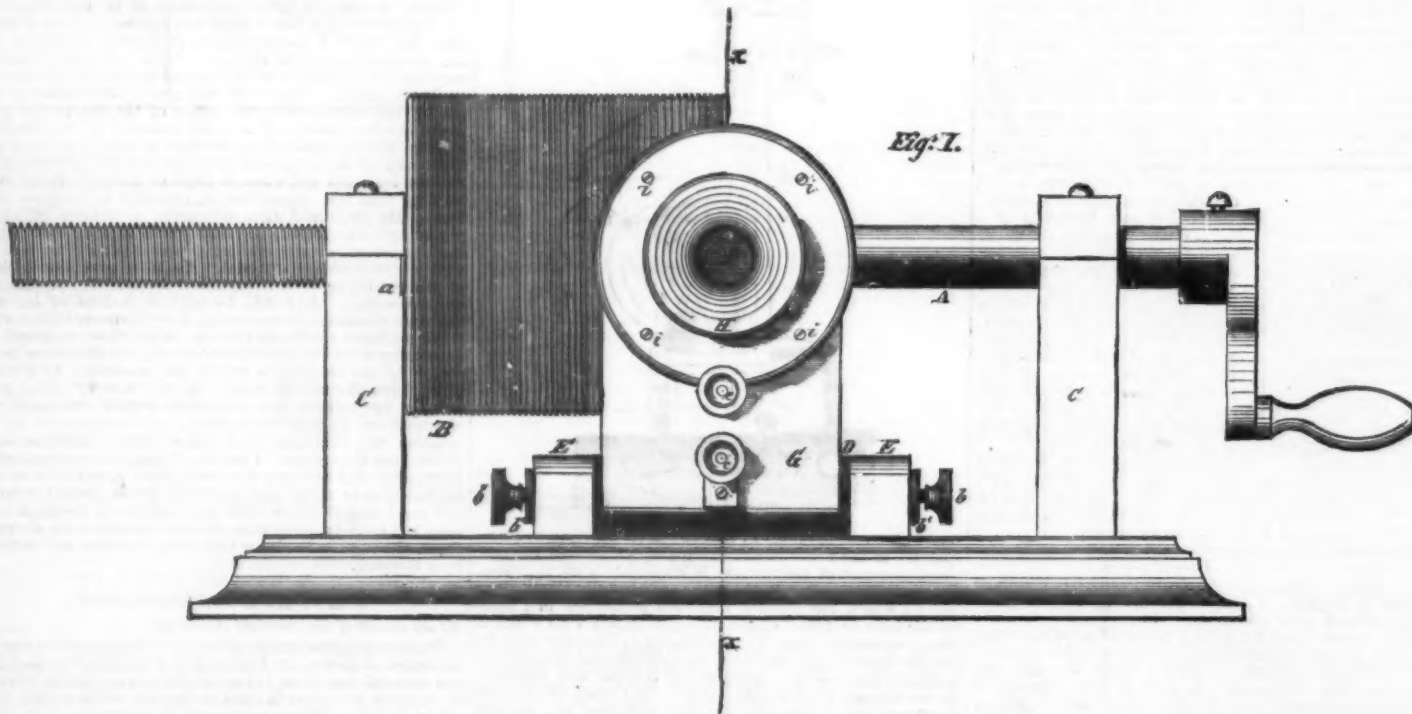
Now that Edison has invented the Phonograph, it is easy enough to make one, and every one wonders that it had not

Under the cylinder and centrally between the standards a block, D, which is 3¼x3¼ inches and 1 inch thick, is firmly secured to the base piece. To opposite edges of this block are secured the cross pieces, E, and to the middle of the block a stop, F, is secured which is of the form shown in the engraving, and 1 inch thick.

Pointed screws, b, which are provided with lock nuts, b, pass through the front ends of the cross pieces, E, into metallic plugs inserted in the edges of the diaphragm support, G, and form its pivots. This support is held in position by the screw, c, which passes through it into the nut, d, which is externally threaded and screwed into the block, D, and stop, F.

The position of the support, G, is regulated by the screw, e, which passes through it and rests against a metallic button, which is inserted in the stop piece, F.

The diaphragm support, G, is ¾ inch thick and 8 inches



WORKING DRAWINGS FOR A PHONOGRAPH.—SCALE, HALF SIZE.

of a colloid in modifying the crystalline form of salts; for instance, sulphate of copper crystallizes from gelatine in the globular form, retaining only 3½ molecules of water. He also showed the effect of a steam jet in boring through a block of ice, mainly with a view of obtaining suggestions as to the use of such a method in the commercial preparation of ice.

Mr. Rutherford then showed a photograph of the solar spectrum from the line E to H, taken by means of a grating. By means of a heliostat he concentrated the rays on a lens within a collimator, which, in relation to the observing telescope, was of considerable length, in order to admit as much light as possible, and the grating was movable. The enlargement was effected by inserting a lens near the focal point of the observing telescope, and he used a sensitive colloid which gave the greatest sharpness of definition about the line G.

Sir W. Thomson hoped that Mr. Rutherford would measure the wave-lengths of dull radiant heat, as such rays are

been done before. The Phonograph, truly wonderful as it is, is exceedingly simple and may be made at a slight expense.

The accompanying engravings represent two forms of a small phonograph which will work admirably, and do all that any of the hand machines will do. In the illustrations, which are half size, Fig. 1 is a front elevation. Fig. 2 is a vertical section on line x x in Fig. 1. Fig. 3 is a plan view of a cheap form of phonograph. Fig. 4 is a transverse section on line y y in Fig. 3. Fig. 5 is an end elevation, Fig. 6 a face view of the diaphragm, and Fig. 7 shows details of the screw bearing.

The shaft, A, in Figs. 1 and 2, is ¾ inch in diameter, 15½ inches long, and has upon one end a 2 inch crank, and is threaded for five inches from the other end. The iron cylinder, B, which is 4 inches long and 4 inches in diameter, is bored axially, and secured to the shaft 5 inches from the threaded end, and has a screw cut upon it of the same pitch as that upon the shaft. The pitch of the thread should

wide, and is bored out to receive the diaphragm, f, and mouthpiece, H. The opening in the support, G, is of two diameters; the larger part, which receives the mouthpiece and diaphragm, is 2¾ inches in diameter, and the smaller part exactly 2 inches, leaving a flange, g, which is 3-16 in. wide and ¼ in. thick, and leaving 2 inches of the diaphragm exposed.

The mouthpiece, H, has an annular bearing surface which corresponds in width to the flange, g. The smaller part of the opening through the mouthpiece is ¼ in. in diameter.

The mouthpiece has a flange, h, for receiving screws, i, by which it is secured to the diaphragm support.

The diaphragm, f, is clamped between two rings of blotting paper, and is damped by two or three pieces, j, of elastic tubing placed between it and the inner surface of the mouthpiece, H.

A delicate wooden spring, k, having the head or mallet, l, is secured by screws to the diaphragm support, G, and the

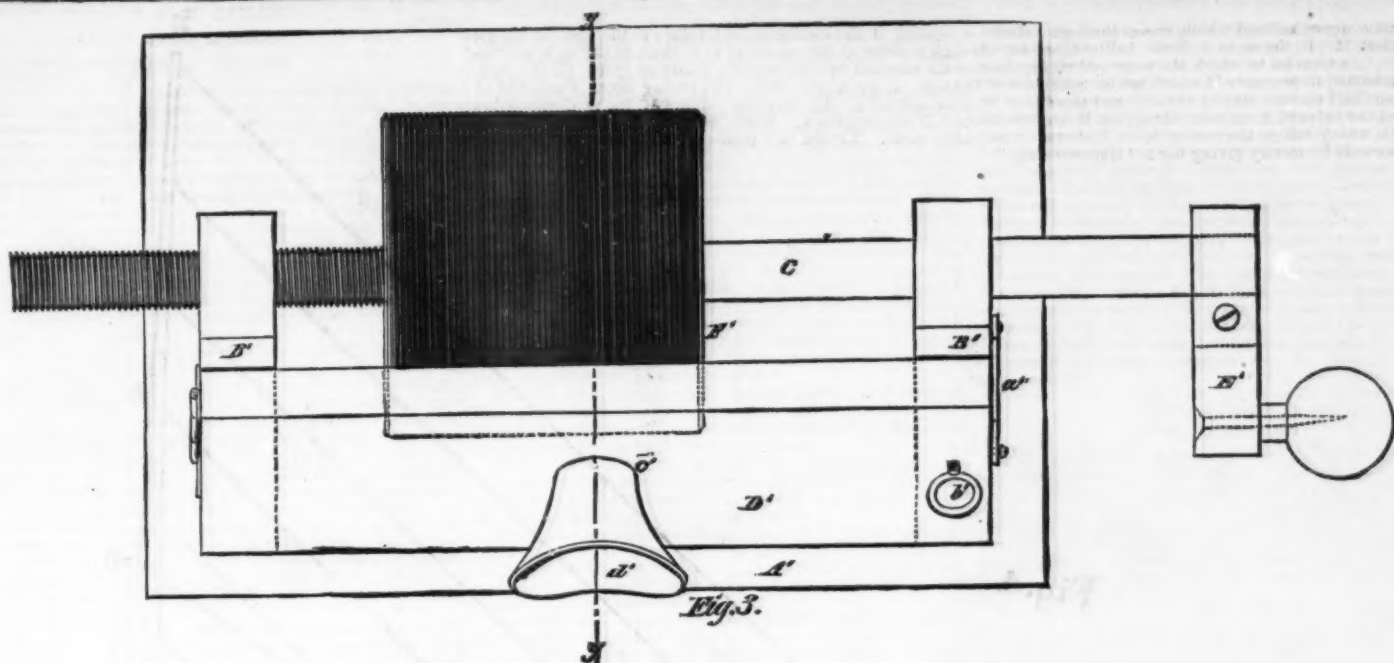


Fig. 3.

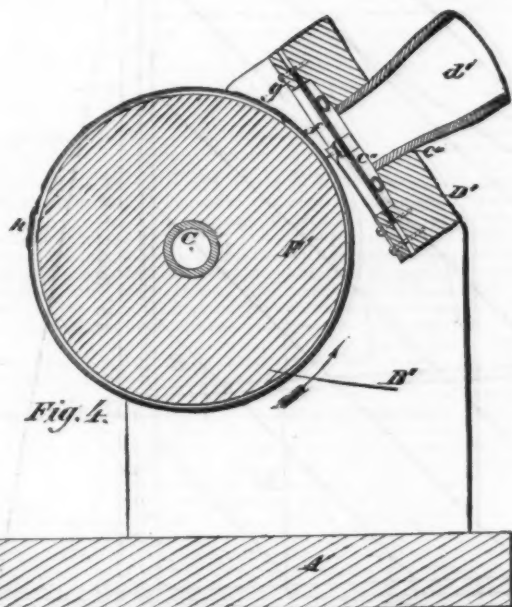


Fig. 4.

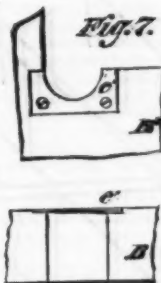


Fig. 7.

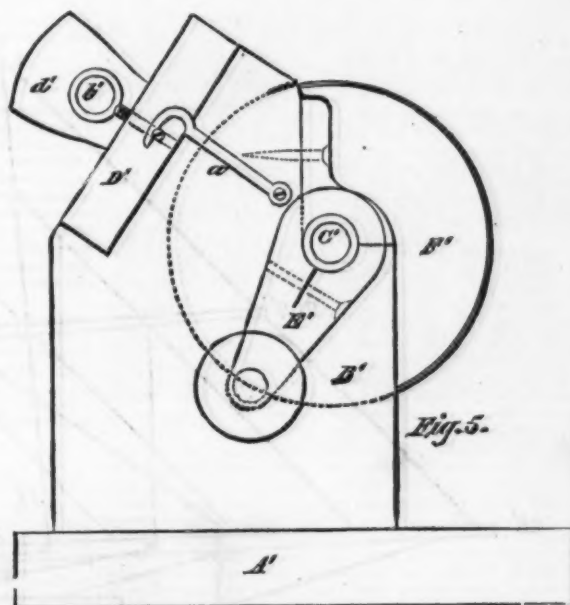


Fig. 5.

WORKING DRAWINGS FOR A PHONOGRAPH.—SCALE, HALF SIZE.

head, *l*, rests upon a thin piece, *m*, of elastic rubber, which is placed upon the center of the diaphragm.

The best material for the diaphragm is thin ferrotype plates, procurable at the photographer's. The head, *l*, is drilled to receive a needle, *n*, which projects about 1-16 in. and is quite sharp. The point, however, should be slightly rounded and shaped somewhat like the point of a leather awl, with the edge arranged parallel with the axis of the cylinder. The width of the point must be very slight indeed, and the needle must always be kept in good condition. If the needle is too sharp it will cut and scrape the tinfoil; if too dull, the articulation will be muffled. The needle may at any time be sharpened without removing it from the instrument by using a small oilstone slip. Before placing tinfoil on the cylinder the needle must be adjusted by the

a slight groove in the tinfoil, as the cylinder is turned. After this adjustment the screw *c* need never be changed.

Now, by speaking rather loudly in the mouthpiece, and at the same time turning the cylinder, the speech will be recorded upon the tinfoil. After loosening the screw *c*, the cylinder may be turned back to the point of starting. The needle may again be brought into contact with the foil by turning up the screw *c*, when, by turning the cylinder forward, the speech or other sounds will be reproduced.

It is found advantageous to speak to the instrument through a short tapering tube, the smaller end of which is $\frac{3}{4}$ inch in diameter and the larger end $1\frac{1}{2}$ inch in diameter. The tube should be about 4 inches long.

When the instrument is made to speak a conical paper resonator, 16 or 18 inches long and 5 or 6 inches diameter at the larger end and $\frac{3}{4}$ in. diameter at the smaller end, should be inserted in the mouthpiece, as it greatly re-enforces the sounds.

Figs. 3 to 7, inclusive, represent a phonograph for which the materials may be purchased for \$1.50. In this instrument the base piece, *A*, is $7 \times 11\frac{1}{4}$ inches and 1 inch thick. The standards, *B*, are of the form shown in the engraving, and 1 inch thick. They support the shaft, *C*, $3\frac{1}{2}$ inches from the base, and are cut off diagonally to receive the diaphragm support, *D*, which is hinged at one end and fastened by a hook, *a*, at the other end.

A screw eye, *b*, having its point filed off, is screwed through the free end of the diaphragm support and rests against the standard, *B*, and serves as an adjusting screw for regulating the needle. There is a $\frac{1}{4}$ inch hole, *c*, exactly in the middle of the part, *D*, for securing the mouthpiece, *e*, and in the under side of the part, *D*, concentric with the hole, *c*, there is a shallow circular recess, *c'*, which is 2 inches in diameter.

The shaft, *C*, is made of a piece of mandrel drawn brass tubing, $15\frac{1}{4}$ inches long and $\frac{1}{2}$ inch external diameter. It needs no turning, and it may be threaded by any steam or gas fitter. The length of the threaded portion should be the same as in the phonograph described above, but the lead may be somewhat coarser, say 14 or even 12 to the inch. The nut is made with a steel plate, *e*, screwed to the standard as in the other case.

The crank, *E*, is of wood, and is split from the shaft toward the handle and clamped tightly on the shaft by the screw shown in dotted lines.

The cylinder, *F*, in this machine is made of plaster of Paris, and is turned off in the frame.

The method of making the cylinder is as follows: Drill two holes through the shaft at right angles to each other and insert two short pins, which will hold the cylinder in place after it is cast.

Strike two concentric circles on a piece of pasteboard, one $\frac{3}{4}$ inch and the other $4\frac{1}{2}$ inches diameter. Put 7 inches of the smooth end of the shaft through the $\frac{3}{4}$ inch hole, and support the pasteboard and shaft, so that the shaft is vertical and at right angles to the pasteboard. Take a piece of stout, smooth paper, 4 inches wide and 18 or 20 inches long, and form it into a cylinder $4\frac{1}{2}$ inches diameter, and fasten the overlapping ends by means of pins or a string, and set it upon the $4\frac{1}{2}$ inch circle on the pasteboard. Secure it in place with a little plaster of Paris.

In a suitable vessel place 1 quart of water. Sprinkle into it 4 lbs. of very fine plaster of Paris, allow it to settle, pour off the surplus water, stir the batter rapidly, but be careful that it does not become filled with air bubbles; pour the plaster into the paper cylinder and allow it to set; when it becomes hard and before it dries, remove the paper mould, and place the shaft, *C*, in the boxes in the standard and secure the box caps by a screw as shown in the end elevation (Fig. 5). Fit a plug to the mouthpiece hole, *c'*, and drive through it a turning chisel. Block up the free end of the part, *D*, and turn the shaft.

The cylinder revolves under the chisel, and is at the same time moved lengthwise by the screw. The machine is thus temporarily converted into a lathe. By gradually lowering the chisel, as the cylinder is made to traverse back and forth, the cylinder will be reduced in diameter and made true.

When it is $4\frac{1}{2}$ inches in diameter, it is removed from the frame and dried in a warm (not hot) oven. When dry, and while it is warm, it is coated with paraffine, which is allowed to soak in.

When it becomes cool it is placed in the frame, and a V-shaped thread-cutting tool is substituted for the turning chisel, and the thread is cut in the surface of the cylinder by causing the cylinder to revolve under the cutting tool as in the case of turning.

The thread-cutting tool must take very light chips, otherwise the cylinder will be rough.

The V-shaped groove need not be deep, and the top of the thread should be wider than the groove. The diaphragm, *f*, is clamped between paper rings, over the recess, *c'*, by means of a thin board, *g*, having a circular aperture which corresponds in diameter with the recess, *c'*.

The diaphragm is damped with short pieces of rubber tubing, and the needle is mounted in the same manner as in the machine shown in Figs. 1 and 2.

The mouthpiece is of porcelain, such as is used for speaking tubes.

The tinfoil is wrapped around the cylinder and lapped as shown at *A*.

The arrow indicates the direction in which the cylinder must be turned.

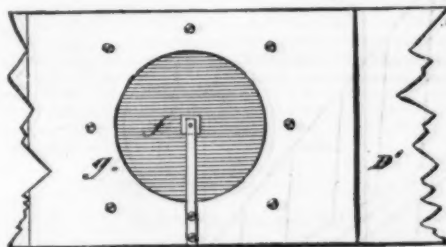


Fig. 6.

screws, *b*, so that it will strike exactly in the center of the space between the screw threads.

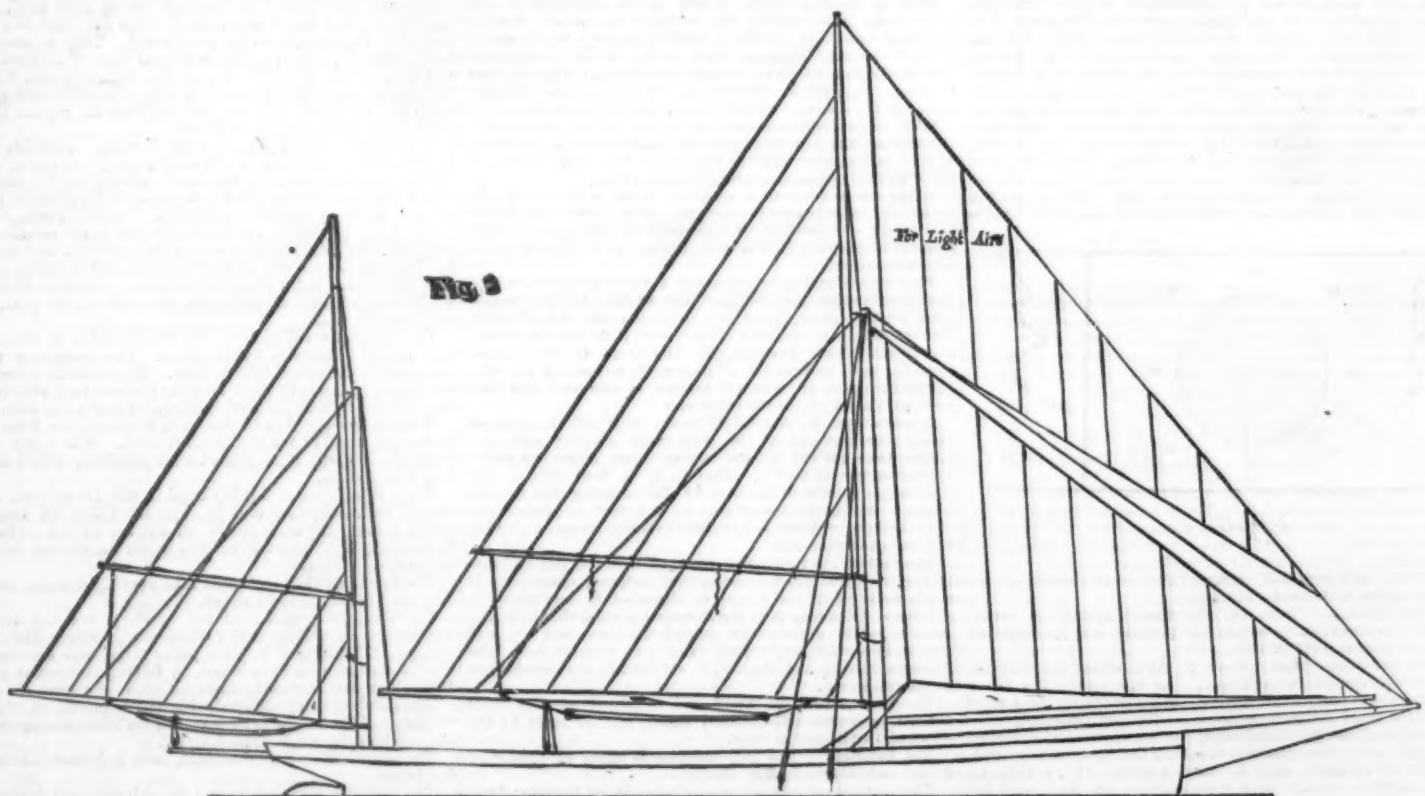
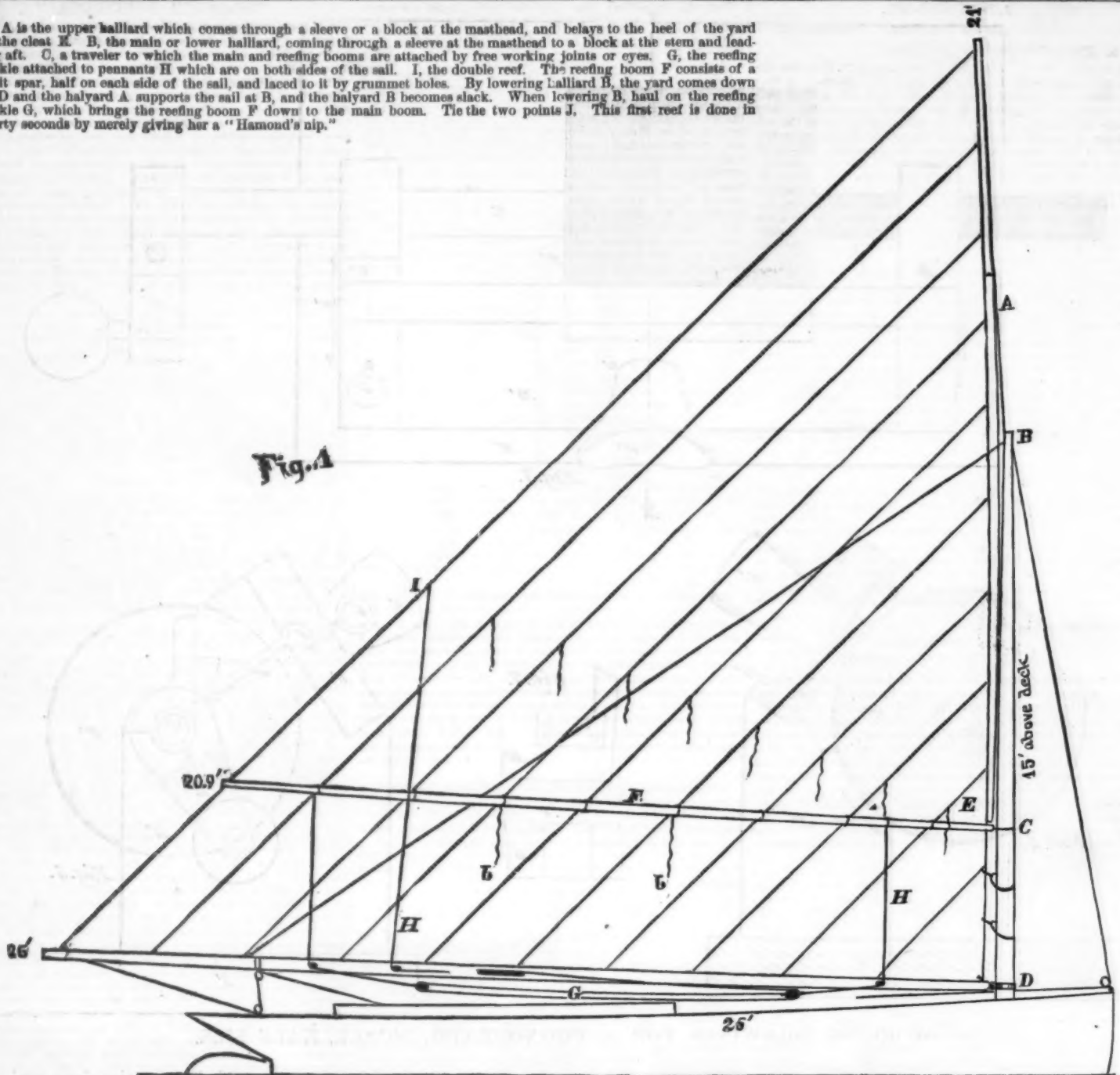
The tinfoil used with the instrument should be rather stout—about 15 square feet to the pound—and it should be cut into pieces 4×13 inches.

The foil is smoothed out on a glass plate and wrapped smoothly around the cylinder, and one end, after being gummed or coated with a little shellac varnish, is lapped over the other end and the joint is carefully smoothed.

It is obvious that the direction in which the foil is lapped depends upon the direction in which the cylinder is turned. While the cylinder may be turned either way, it is found preferable to turn it in a right-handed direction, and the foil accordingly should be lapped from right to left.

Having placed the tinfoil, the diaphragm is adjusted by means of the screws *cc*, so that the needle point will make

A is the upper halliard which comes through a sleeve or a block at the masthead, and belays to the heel of the yard at the cleat K. B, the main or lower halliard, coming through a sleeve at the masthead to a block at the stem and leading aft. C, a traveler to which the main and reefing booms are attached by free working joints or eyes. G, the reefing tackle attached to pennants H which are on both sides of the sail. I, the double reef. The reefing boom F consists of a split spar, half on each side of the sail, and laced to it by grummet holes. By lowering halliard B, the yard comes down to D and the halyard A supports the sail at B, and the halyard B becomes slack. When lowering B, haul on the reefing tackle G, which brings the reefing boom F down to the main boom. Tie the two points J. This first reef is done in thirty seconds by merely giving her a "Hamond's nip."



A NEW CAT-RIG—BY AN OLD SALT.

A NEW CAT-RIG.

By AN OLD SALT.

To the Editor of the Scientific American:

Adopting the old saw that "one good turn deserves another," I beg leave to hand you my new "cat-rig," in two sketches—one of simple cat-rig, under full sail, giving canvas equal to the usual sail, and one of a yacht-rig. Any competent sailor of small craft will at once realize the advantage of taking in a deep reef without any disturbing movement of the crew. All that will be necessary will be to slack down the main halliard and haul down the reefing-boom to the main boom, just as a Chinaman reefs, by lowering one bamboo; and in taking in the double reef, as there is no tack-lashing to fasten, the crew have only to top the boom, haul out the earing, and tie the points, or to slack down the yard, without topping the boom, until the points are tied, and then top the boom and hoist the yard to suit the taste of the skipper.

Under full sail the upper halliard has no strain on it. In lowering the sail to reef, the upper halliard being belayed to the butt or lower end of the yard, it follows that the weight of the yard brings the strain upon the upper halliard and relieves the lower. In the usual cat, having about one-third of the sail outside the stern, to reef while going along is a difficult operation seldom well done. Under ordinary circumstances, where there is plenty of sea room and no competition, it will be well to luff into the wind and haul down the reef-boom, which can be done, without losing headway, in less than one minute. In racing in squadron, where one must keep on straight, the reef can be hauled down, when close hauled, by easing the sheet off for a minute; and if the second reef is to be taken in, slack off the sheet and haul out the earing, thus practically reducing the sail without tying the points.

Every man fit to sail a small craft in rough waters will see at a glance of the sketches that a boat rigged after this style must be much safer and more likely to win the prize than one of the ordinary rigs, where a gaff topsail is a nuisance, and where reefing snug under way is difficult and likely to put the craft out of trim. In this rig there is no crawling forward to haul down the tack in reefing; no movement necessary out of the standing room, and the ability to let out the reefs and make full sail in a very short time.

MILTON, MASS., July, 1878.

R. B. FORBES.

A LIVE WHALE IN LONDON.

We have once more a live whale in London, a fine animal, showing no signs of organic damage in transit, plump, notwithstanding its many days' fast, and exhibiting an activity that promises well for its healthy life in captivity. Two others arrived at Liverpool by the same ship, the *Circassian*, of the Allan Line, from Quebec. One was taken to Manchester and the other to Blackpool. Mr. Farini, by whose enterprise all three were secured and brought to England, received telegrams afterward stating that the Manchester and Blackpool arrivals were looking healthy and enjoying their tanks. It will be recollected that the last whale that was brought to London died soon after its arrival. It was the first that had been brought alive, and a *post mortem* examination was held by Prof. Flower, Prof. Garrod, and others, as to the cause of death. It arose practically from a severe cold. The experience then gained has not been thrown away. The blow hole of this specimen in London shows no trace of mucous inflammation, and it is stated the two others are equally clear. The conditions under which the animals are obtained and brought over are these: They are caught off the coast of Labrador by surrounding them by a line of boats and so driving them up on the top of a tide on to the shore. As they are stranded on the retreat of the tide they are put in cases suited to their size and packed in seaweed. They are then put on a sloop specially engaged to run to Quebec, and then transferred to steamer. Mr. Zack Coup, who has captured 125 whales alive, and has supplied all the specimens shown in any aquarium, we are told, undertook the entire management of this expedition, and, with four men specially engaged to relieve one another in throwing water over the whales during the whole journey, brought his charge to Liverpool early yesterday morning. Mr. Farini was present at the disembarking, and Mr. Carrington, the naturalist of the Westminster Aquarium, was in attendance to take charge of the specimen for London. The Allan Line owners and the Northwestern Railway Company, recognizing the scientific interest attached to the undertaking, offered unusual facilities, and many little difficulties were smoothed over by their help. The train with the truck carrying the whale arrived in London soon after 5 on May 30, when the case was removed to a van which reached the Aquarium at 6:15. Very little time was lost. The case was hauled out of the truck and carried to the tank on the shoulders of 21 men, the seaweed was taken out, one side of the case was soon sawn asunder and taken off, during all of which time water was poured over the animal's head, and by 6:33 a chorus of cheers went up as the whale took to the water. There was anxious suspense for more than two minutes as to what would happen, but the whale then rose and gave a vigorous blow, and after this it took to swimming more and more actively, and by rolling along the bottom began to clear away the remnants of the skin hardened during the voyage, and so regaining its proper white color. It is a Beluga, and its length is 13 ft. 6 ins.—*London Times*.

MANNERS AND MORALS.

By GEO. B. EMERSON, LL.D.

THE connection between manners and morals is more intimate than is usually held. He who undertakes to act as if he were a perfect gentleman, and perseveres in his purpose, will be likely to become one. The resolute and sustained exhibition of the exterior of gentleness, delicacy, kindness, civility, and generosity will not fail to act inward upon the character and produce something of the reality of those high qualities. Players tell us that they feel the character they endeavor to personate. Whoever will pertinaciously take upon himself the manners of a gentleman will end by becoming one. And I need not say that the qualities which characterize a true gentleman are among the best that can adorn humanity. A delicate and habitual regard for the rights and feelings of others; the foregoing the convenience and gratification of one's self for the convenience and gratification of others; the yielding up, voluntarily and cheerfully, the better seat and the better position and the better word to another—these, without which a man is but a poor imitation of a gentleman, are very nearly allied, to say the least, to that self-sacrifice which is the best and highest attainment of a Christian.

I should not call up these admitted and almost commonplace truths were it not that, in the most important act which any man can perform for the benefit of his own children and other men's, they are apt to be forgotten. I refer, of course, to the act of choosing a teacher.

The highest, most important, and essential qualities of a teacher are apt to be forgotten at the moment when the teacher is chosen, who is to have a most powerful influence upon the whole character of all the pupils in the school in which he is to labor. Most committee-men are too ready to be satisfied if they can find a teacher competent to teach satisfactorily the branches which are to be learned in school. They certainly are important; and no man can teach well what he does not perfectly understand. It is right that the examiner should insist upon a candidate's possessing this knowledge in a high degree. But as it is more important that a boy should be brought up to be a good man than a good reader, an honest and just man than a skillful accountant, a kind and civil gentleman than a handsome writer, so it is more important for a school committee-man to regard the moral and social qualities of the teacher than those lower ones of competence as an instructor.

The best thing a man can do for his children, next to being himself the kind of man, in character and in manners, that he would wish his child to become, is taking care that their teacher shall be the right kind of a person.

The most important qualification for a teacher, beyond all comparison, is his moral character. He should be a person of the highest moral character. He should be a person having the highest title from the highest motives.

The next qualification in importance is good manners. He should be in this respect a person whom his father is willing to hold out to the imitation of his child in every particular. Committee-men cannot be too particular in their choice.

A teacher will, especially if he is a person of ability, leave the impress of his character, be it good or bad, upon his pupils. Everything that is excellent and noble in him will have a tendency to produce excellence and nobleness in them. Everything that is bad will tend to reproduce itself in like manner. This fact need not, even for a moment, lead a committee to undervalue those qualifications which are now considered essential.

Fortunately it is true that the very person who has the highest moral nature could, on that very account, be the best teacher. The great defect in almost all our schools is want of thoroughness; and want of thoroughness is more a moral want than an intellectual. A man of wise and lofty conscientiousness will naturally insist on having everything that is done done as well as it can be. He will desire not to make a momentary impression at the examination, but a permanent impression upon the character. He will insist upon the pupils doing right because it is right; upon good order and method, punctuality and economy in the use of time. Not only, under such a management, will more be done and better, but better habits will be formed, a thing even more important than what is done.

If Good Morals could speak, he would say of every person he met, "What can I do for this person's best welfare? Good Manners would ask, "What can I do to add to this person's happiness and enjoyment? Good manners, therefore, living with such kind intentions, is always convincing.

What good morals will teach to do well, good manners will teach to do cheerfully and heartily.—*N. E. Journal of Education*.

THE NYASSA REGION IN AFRICA.

At the Society of Arts, London, Mr. H. B. Cotterill recently lectured upon the prospects of commerce and colonization in the region of the Nyassa. Admiral Ommanney presided, and, in introducing the lecturer, said that Mr. Cotterill had just returned from Africa, where he had gone over many hundreds of miles never before traveled by Europeans. The lecturer urged that it was England's duty not to waste more money and life in useless exploration, but to use zeal, common sense, and money in securing footholds and centers for civilizing influences. This had been done to some extent at the Nyassa. He sketched the suppression of the slave trade on the coast line, and stated that the word "suppression" exactly expressed the circumstances of the case. The trade was scotched, but by no means dead. Were the pressure put upon the trade relaxed, slavery would again revive. Not until England's influence was felt in the interior would the death-blow to the trade be given. The advantages which the Nyassa offered for commencing beneficial influences upon the interior were that there existed a great lake settlement; the accessibility of the Nyassa, both by land and water, as compared with other lakes; the magnificent water-way supplied by the Nyassa itself to the very heart of the continent, and the commanding position that any settlement at the north end of the Nyassa would hold. With two comparatively short breaks, it was shown by the map that up to the center of the continent there was a continuous water-way connection from the delta of the Zambesi to the delta of the Nile. It was true that African rivers were of difficult navigation, and that the lakes were subject to violent and sudden storms; but how such natural obstacles could be overcome was evident, not only from the fact of General Gordon's success in the North, but from the fact that the little Ilala had penetrated by this water-way to the distance of nearly 1,000 miles. He then described the route by water, commencing on the Zambesi and Shire rivers; dwelt upon the delights of the region of the Lake Nyassa, and spoke of the sport he had with rod and line on the lake. The lecturer thought that the more northerly parts of the lake were far more beautiful and more populous than the granite country of the south. Ivory was stated to be in abundance, as well as the teeth of the hippopotamus. There was evidence of the presence of precious metal. Cotton grew wild, and was also cultivated by the natives. Sugar-cane, grains of various kinds, yams, bananas, and the like grew luxuriantly. Indigo and coffee would probably thrive. The timber was fine, especially toward the north. The exploration of the other parts of the Lake Nyassa was described by means of a large map. He stated that by the munificence of one or two private persons a direct road had already been begun of about 300 miles to the north of Nyassa, and he contended that there were great facilities for establishing, by the aid of the water-way, a settlement in the heart of Africa, with the advantage of a line of communication. Such a settlement would command all the country to the west of the Nyassa, all the ivory wealth of the Uwiva land, and the south region of Tanganyika, now diverted by the very circuitous routes through Ujiji to the north, or Kota Kota and Kilwa in the south. In answer to questions, the lecturer said that the lake region, when once a person had become acclimatized, was as healthy as India. The marsh lands he described as exceedingly unhealthy.

LONGEVITY IN IRELAND.

THE Irish Registrar-General reports that there were 93,500 deaths registered in Ireland in the year 1877, and that in 67 instances the deceased was described as aged 100 years or upward. Some of the local registrars inquire into the truth of these statements. In the return which has been recently issued for the last quarter of the year 1877 the Registrar of Bantry reports the death of a woman 109 years old, and says he had personal knowledge of her, and has every reason, from inquiries made, to believe that the age was not exaggerated. She had full use of her faculties, and up to a few weeks before her death was able to move about. The Registrar of Portaferry, Downpatrick, records the death of a woman also 109 years old, and "has good reason for believing that her age was understated." The Registrar of Coolmountain, Dunmanway, who registered the death of a man 100 years old, "has no doubt, from inquiries made, that the age is given correctly. He used to smoke, but never drank to excess. He was accustomed to undergo great hardships in wet and cold, but always took the precaution as soon as he entered his house to undress and dry himself perfectly with a towel."

HORACE MANN.

By MRS. MARY MANN.

You ask me for something "never before published" about my husband. There are papers of his own never before published, but this request meets a wish I have had to speak of him in relation to the advanced views of early education introduced among us by the system of Friedrich Froebel; and this all the more as he had been spoken of mistakenly by a distinguished thinker and educator, Dr. Seguin, who has done so much to restore to humanity and to society the poor idiots.

Dr. Seguin says, in a late publication: "When Horace Mann (in 1843) made his celebrated report on the popular schools and methods of teaching in Europe, he did not say a word of the kindergarten, nor name Froebel, but signified as the two foremost objects of his admiration the teaching of the deaf mutes to speak and the first school for idiots at Bicêtre." If this indefatigable inquirer had found traces of a kindergarten in Europe, it would have been he, and not his wife and her apostolic sister, Miss E. P. Peabody, who would have preached the said news of the movement-school and of the pleasant learning.

So far Dr. Seguin is correct; but when he adds the following, he writes of what he does not know: "Far from it; Horace Mann remained the professor of strict discipline, progressive but Puritan, who never heard of a play school, nor dreamed of becoming the teacher who dances and plays with his children like a 'natural fool.'" (The designation given to Froebel by the first outside observers of his school for little children, afterward called a kindergarten.)

It was after Mr. Mann's visit to Europe that he had children of his own, and no kindergarten ever danced and played more, to put it epigrammatically, than he did with his children. A new world opened upon him with his children, much as he had loved and labored for other people's children before; and Froebel himself did not think more of consulting their natures and tendencies in education than he did, though his own Puritan training did hamper him in the quest. They were not sent to school early, because he knew of no schools for young children that he would have sent them into. But the home school was one of alternate play and instruction, and the instruction was chiefly in the study of Nature, although they were taught to read early; but this was done on the phonetic system then introduced by Dr. Kraitir, and therefore a very easy process, which the children almost took in hand themselves. The handling and classifying of flowers, shells, and minerals were begun by collecting and arranging them, and gradually became more systematic. One child excelled in this; another in the relations of numbers; and the bent of each was fostered or moderated as judgment required. When the eldest child first went to school his chief interest was in some lessons in mineralogy given by the principal of the model school attached to the Normal School of West Newton, Mass.; and when a friend, knowing the interest of the child in this science, gave him a barrel of Russian minerals, mostly labeled, the happiness of the little boy was indescribable, and the gift was a source of pleasure and further advancement to him all his life. His father's talks were upon the wonders and beauties of Nature, and these were familiar talks upon his knee (his knee had to hold three listeners at last), and were in response to the eager communication of the children and their untiring questions, which were never put aside. Visits to manufactories and workshops were a part of this natural training, and at the age of ten the eldest child was quite a little chemist, and had a pretty good laboratory in the cellar, where he did not blow up the house, as it was sometimes feared he might do. When he was removed to the neighborhood of an iron foundry in Ohio, the smelting of metals was added to his pursuits, and he built an oven of fire-brick, with his own hands, against the chimney in the cellar, and with a pair of foundry-bellows which his father purchased for him, and the help of a younger brother, satisfied himself with his own experiments, and could describe every iota of the processes he spent much time in watching at the foundry—as often as his mother could go with him to keep him out of the fire.

None of these pursuits were imposed upon him, but his father used to say to me, "Give them every facility, and spare no expense to furnish everything they need for their development. They shall never suffer for want of opportunity as I did." When he was afterward crammed at school by teachers whose ambition to display what they could do with their pupils' knowledge outran their discretion in imparting it, he was taken away and restored to the home school to pursue the same subjects, moderately and happily, out of the atmosphere of school competition, which his father considered the evil feeding of a propensity only too strong in human nature, and whose stimulation makes wrecks of so many fine minds.

To cultivate the human faculties in their proper order was a quest with him as with Froebel, and no one would have hailed more joyfully or promoted more earnestly, as Dr. Seguin allows, so genial and philosophical and educating a system as Froebel, by long thinking, had worked out. In looking back upon his own defective early education, he often felt like weeping over what he had lost and what he might have done, when he saw the enjoyment of his own children and one or two others who came under his domestic care, in the unfolding of their faculties, and in their delight in creation, which was so long to him a sealed book, the key to which he received too late. Stern necessity obliged him to get his living independently, and when, late in life, he

* This was Dr. Seguin's school, which was begun in the middle of a room, in a space twelve feet square, where the inmates were confined.

had access to any opportunities, he was obliged to shut himself up to a prescribed course; but what he achieved in the path he pursued was but an earnest of what he might have done if he could have followed his own strong bent for culture. He could at least clear away the obstacles for others, and this he did as soon as duty left him free to do it. The study of nature was his early passion, and he was not only circumstantially but peremptorily cut off from it. The cultivation of aesthetic tastes was also thought positively wrong and frivolous by the narrow Puritan views of his day and his surroundings. When he left the care of his "80,000 children," as he called them, for the more limited charge of a college, he could no longer elaborate systems of early education.

It is rarely that parents learn of their children as he did, and he did it because he lived with them, in the sense in which Froebel uses the words. "To tell papa" was the crowning pleasure of any discovery in nature or any acquisition of knowledge. His sympathy was complete and fruitful as well as sure, and its fruitfulness was duly prized. If children have any education at home, or if it is even duly watched at home, it is usually the mother who does it; but Mr. Mann shared in the watching and the ministering in spite of his arduous labors in other fields.

Another feature of the "New Education" may also be paralleled in his domestic one. It was the cultivation of social relations with other children, which must begin in childhood if they are to be genuine or to be educating. Wherever they were thrown into contact with others he favored a still closer social tie, and thought this could only be reached in the domestic circle. To have children together under guardianship was as important in his eyes as in Froebel's, that evil influences might be forestalled. One of his children was made wretched by a school companion—indeed this happened twice in the child's life—and the lightning was drawn from the cloud in both cases, not by repulse and separation, but by inviting the obnoxious companion into the family circle, making a friend of him, and

TOBACCO AT THE PARIS EXHIBITION.

THE exhibits of tobacco at the Paris Exhibition, which are included in Classes 46 and 51, do not by any means represent the importance which is assigned to it by modern industry and commerce, and which represents an annual expenditure of many millions, and of enormous additions to the revenue of almost every State. At the Exhibition, beyond the remarkable collection in the French Section, there are shown here and there samples of leaves and manufactured tobacco. In some countries tobacco constitutes the principal element of agricultural and industrial wealth, and in almost all nations its manufacture, whether a monopoly or free, would have offered valuable information had the machinery employed and the products been exhibited. It would be useless to attempt any categorical résumé of the various exhibits connected with this industry, but it will be of some interest to give a general review or summary of this branch of industry but little known to the public, as well as statistical data more or less complete. With this object in view we may consider the subject from three points of view, the agricultural, industrial, and fiscal. Every one knows that tobacco is indigenous to America, and that it was imported to Europe toward the end of the 16th century, but it is only about fifty years since the culture has been widely developed in this continent, where to-day, with the exception of this country, where its growth is forbidden by the Government, it is cultivated almost universally either in a condition of absolute freedom or under Government restrictions more or less rigid. The tobacco plant was introduced into Asia, Africa, and the East Indies about the same epoch that it became known here.

Tobacco culture requires much care and favorable conditions for its successful development; it demands a temperate climate, and arrives at its highest perfection in districts favorable to the growth of the vine. It exists in numerous varieties, the characteristics of which are more or less marked, according to the origin of the seed and the influ-

growth. All other things being equal, the proportion of nicotine will be greater the wider the plants are set apart, the fewer are the number of leaves left, the higher the latter are grown on the stalk, and the later the crop is gathered. Thus, only to quote a few of the most striking figures, the proportion of nicotine is reduced by 50 per cent. when the number of plants per acre exceeds 5,000 to 8,000; it varies in the proportions of 1 to 1.27 and 1.73, according to whether 14, 10, or 6 leaves are left on each plant; and finally, by gathering the Havana tobacco, for example, fifteen days before it has arrived at full maturity, the proportion of nicotine is only 3 per cent., instead of 6 or 7 per cent., which is the normal for ripe plants. From these deductions it results that if it be desired to obtain mild tobacco, the plants should be grouped more closely, the leaves be left more numerous, that in harvesting the foot leaves should be separated from those of the crown, and that the crops should be gathered some short time before the unmistakable signs of maturity are marked. The planter finds a great advantage in following these indications, for although the leaves are less developed, in proportion as the plants are grown nearer together, it is equally sure that the weight of the crop increases by 60 per cent., and the number of plants is raised from 5,000 to 8,000 per acre; while there is no real objection to an early harvest, since the weight of the leaf increases scarcely by 10 or 12 per cent. from the time when it has reached its full development, and when it arrives at maturity, that is to say, during a period of time varying from fifteen days to two months, according to atmospheric conditions. Thanks to the practical adoption of these rules, tobacco culture may insure products possessing naturally the qualities required by the manufacturer, without the latter being obliged to resort to artificial expedients to produce them.

We have devoted some space to the consideration of these technical details, because they refer to the most remarkable advance made in the culture of tobacco during the last ten years, and it may be added that this is not the only instance



THE AQUARIUM AT THE PARIS EXHIBITION.

turning his teasing annoyances into friendly offices. Both parties were thus benefited, one by being humanized, the other by helping to humanize, and one can hardly tell which party was most benefited.

To appreciate every one by their motives and their efforts, rather than by their successes, was also another principle he inculcated, thus preventing the growth of spiritual pride in the more favored individuals, and fostering the feeling that every one has all the germs of goodness, and that these only need opportunity to grow. He was a stern man to evil, but not to the evil-doer, unless he persisted in his evil against the light. No heart melted quicker at the sign of self conviction, and he knew well how much there is in life to obscure the light. Such a man could not believe in original sin or in everlasting punishment, but none knew better than he that "the way of the transgressor is hard," and that sin is its own punishment as well as virtue its own reward. Could a man of such convictions ever cease to act in the cause of improvement?—*Cambridge (Mass.) Tribune.*

THE AQUARIUM AT THE PARIS EXHIBITION.

THE Aquarium, on the Trocadéro, is one of the prettiest features of the Exhibition grounds, and, as far as we can judge, is somewhat novel in its construction. Instead of a series of rectangular galleries, with tanks on each side—the general form in which aquaria are constructed—a most picturesque rocky has been formed, over which the visitor first wends his way, crossing waterfalls and rivulets by means of rustic bridges, and gazing down into still ponds at huge trout or carp gamboling beneath. Then a flight of steps is descended, and the visitor finds himself in a tortuous series of subterranean grottoes, into the walls of which are let huge panes of glass, through which he can see a lateral view of the ponds which he has been admiring from above, and can thus study the habits and customs of their inmates from two separate points of view. The tanks appear to be somewhat higher but hardly as long as those in the larger British aquaria.—*London Graphic.*

ence of the soil and climate. Leaving the classification of these varieties to the botanist, we may observe that for the manufacturer there are two categories clearly marked—the light leaves suitable for the manufacture of cigars and smoking tobacco, and the strong-flavored leaves employed for the production of snuff and chewing tobacco. There are many shades of difference in these two classes, indicated by the flavor and aroma, and in their leaves for the first named purposes, by the higher and lower shades of fineness and of resistance of the leaf tissue, and of its suitability for burning. The processes of culture vary but little in any country. The farmer, according to the care he bestows in preparing the ground, in the selection of the seed, in the planting, harvesting, and drying, produces better or inferior crops, dependent of course on the nature of the climate and local influences. Until lately tradition and experience were the two sole guides which the planter possessed; but now, thanks to the progress made in agricultural chemistry, certain absolute laws have been deduced, which permit the cultivator to produce with almost unvarying effects the qualities most desired, combustibility and richness in nicotine. The long series of experiments made between 1860 and 1866 by M. Th. Schliesing, Director of the School of Applied State Manufactures, leaves no doubt on this point. This celebrated chemist has shown that a natural tobacco is combustible when it contains a sufficient proportion of salts of potash, and that it is incombustible if the proportion is insufficient, and that the test of combustibility or incombustibility is the presence or absence of carbonate of potash in the ashes. From this observation he deduced the practical conclusion that to obtain a good burning tobacco (which is an essential quality for smoking) it was necessary to select a soil rich in potash or to enrich the ground by potash manure. About 300 lbs. per acre are sufficient to fertilize the poorest kind of ground. He showed equally that the strength of tobacco depends on the amount of nicotine it contains, and that this quality depends in its turn on four elements, the spacing of the plants, the number of leaves per plant, the position of the leaves on the stalk, and the time of

in which precise science has been applied to industrial agriculture, as for example in the excellent results which have been obtained in Germany and this country in the cultivation of the beetroot. We may, however, mention in passing the ingenious arrangements devised by M. Schliesing in his laboratory in pursuing his investigations, and which are grouped in a part of the pavilion devoted to the exhibits of the Direction of State Manufactures at the Champ de Mars. These will be fully treated of on another occasion.

After this general review of the principles which now govern the tobacco culture, we will proceed to consider the importance from an agricultural point of view of the various countries growing tobacco, and as far as possible the commercial importance resulting from it.

1. *Germany.*—Tobacco is cultivated in most of the German States, but it reaches a real importance only in Prussia, Bavaria, the Grand Duchy of Baden, Hesse, and Alsace-Lorraine. In 1876, it occupied an area of about 54,000 acres. To give an exact idea of the position and extent of the various districts under culture it is necessary to eliminate the political divisions of the country, and to consider only the geographical arrangement, when it will be perceived that the greater part of the production is concentrated in the valley of the Rhine (the Palatinate and Alsace) and on the adjacent slopes, where it occupies about 37,000 acres, that is to say, 70 per cent. of the total area, while it is almost nil in Württemberg and Bavaria properly called, and covers barely 12,000 acres in the country situated to the north of the Main, that is to say, in Uckermark and in the flat plains of the Oder and the Vistula.

The total weight of the crops when dry was 31,700 tons in 1876 and 1877, and its value was about £653,000. The yield per acre was about 1,300 lbs. weight; it should be remarked that the last-named year was in many districts a bad one, and that the mean production of the last six years amounted to 40,000 tons, having a value of £1,080,000, and that the average crop per acre was about 1,500 lbs. These German tobaccos are almost exclusively light, and of the classes known as the Palatinate and the Paraguay. Germany is



THE PARIS EXHIBITION.—PAVILION OF LA VILLE DE PARIS.

very far from being able to supply her requirements from her indigenous production; she imports on an average 48,000 tons of leaf-tobacco per year, having a value of £4,000,000, and it is from America whence she draws the greater part of this amount. The excess of importations of raw material over the exportation of finished products is about £3,000,000. The tobacco culture is entirely free in Germany and is subject only to land taxes.

2. *Austria and Hungary.*—In Austria as in Hungary, tobacco culture is a monopoly subject to the control of the Government, and it is developed only in the south of the Tyrol, in Galicia, and throughout the whole of Hungary.

The Tyrol produces only the strong leaves, and the crop amounted in 1876 to 3,390 tons in a green state, or 587 tons after drying. The market price was £4 16s., and £34 after manufacture.

Galicia and Buckovine furnished two distinct kinds, one strong and known as Zeburth, cultivated in the environs of Zabletor, and the amount of the crop in 1876 was 2,233 tons, worth £44,000; the other class grown in light and called Ungar-Sallizischer, cultivated near the Sagel-Negar. In 1896, 1,700 tons of this tobacco were grown, worth £31,600.

Hungary is of all European countries the one where the cultivation of tobacco is the most extensive. The area under culture is about 150,000 acres, and the number of planters exceeds 50,000; it furnishes five distinct kinds of tobacco, known under the names of Szyedin, Debreczn, Fünfkirchen, Garden tobacco, and Czerbel tobacco, in which may be included all the second-class varieties or brands, which take their names from the villages or districts in which they are grown. These tobaccos for the most part are manufactured for pipe-smoking. The planter cultivates for the Hungarian and Austrian Administration or for exportation; the amount received by the former in 1875 was 57,740 tons, and the price paid was on an average £19 3s. per ton. The average yield per acre was 850 lbs. The amount grown for exportation does not exceed 1,000 tons per annum. It is important to note that nowhere except in Hungary are the varieties in production so striking; thus from the effect of a bad season, or under the influence of political or commercial depression, the importance of the crops, both for home consumption and exportation, which average 45,000 tons a year, fell to 11,000 tons in 1863, to rise again to 80,000 tons in 1865, to fall to 15,000 tons in 1869, and immediately after to rise rapidly and more steadily. Neither of the two Administrations of Hungary or Austria has exhibited at Paris, but the tobaccos of the country are shown none the less at the Champ de Mars, thanks to Mr. Sigismonde de Schloesberger. Austria, like Hungary, imports a considerable quantity of tobacco leaf from America, India, and especially from the Levant. In 1876 the Viennese Administration purchased 9,220 tons, at an expenditure of £700,000.

3. *Belgium.*—In Belgium the tobacco is not submitted under any Government regulation; it is cultivated especially in the Flemish districts, which are adjacent to the Département du Nord; the production scarcely exceeds 2,000 tons, while the importation rises to the considerable figure of from 6,000 tons to 8,000 tons.

4. *France.*—The culture of tobacco is authorized under special agreements in nineteen departments either for the growth of one or of varied classes; the former are produced in the Nord, the Lot, L'Isle et Vilaine, and the latter in the

Pas-de-Calais, La Meurthe, La Moselle, La Dordogne, L'Isère, etc. Each of these classes is represented at the Champ de Mars in the pavilion of the State Manufactures, by two specimens, the one flattened leaves, intended to show clearly the physical characteristics of each variety, and the other in mass. One ticket indicates for each department the number of acres under cultivation, the number of planters, and the weights of the crops. From this data it will be seen that the principal centers of cultivation are the Lot et Garonne, the Dordogne, Le Lot, Pas-de-Calais, the Nord, L'Isle et Vilaine, Gironde, and the region of Savoie, the annual production exceeding 14,000 tons, and representing a value of £480,000. The area cultivated is about 32,000 acres and the number of planters is 35,000. The mean yield per acre is 1,300 lbs. for light tobacco and from 800 lbs. to 2,000 lbs. for the strong varieties, according to the localities in which they are grown. In Algeria, where the industry is absolutely free, the production reaches 7,000 tons, of which about half is bought by the Administration. The collection of raw material exhibited by the Administration, in which are also shown the principal varieties of foreign growth which the Administration employs in its manufacture, is completed by specimens of the various modes of packing, and also by a botanical guide of great interest, in which are classified scientifically nearly all known varieties of the plant under consideration.

5. *Greece.*—Tobacco culture in Greece is concentrated in Thessaly and Argolite. This tobacco has a very close resemblance to that of Volo, but it is less carefully looked after, although the specimens which are sent by Greek exhibitors to the Champ de Mars leave little to be desired as far as preparation of the leaf is concerned. The tobacco is either used where it is grown or exported to countries on the Mediterranean—Algeria for example. The Administration and western commerce employ only very limited quantities.

6. *Holland and her Colonies.*—The production of Holland reaches nearly 6,000 tons per annum. She grows entirely the strong varieties of leaf, of which quite a considerable portion is sent to Austria, Italy, and Germany; but her colonies, Java and Sumatra, furnish by far the larger portion to the Dutch markets, the colonial production amounting to an average of 140,000 bales, or about 12,000 tons. This class of tobacco is well adapted and largely used for the outsidings of cigars, and it commands prices almost as good as the superior Havana brands.

7. *Italy.*—The growth of tobacco is under Government control in Italy, where the industry is a monopoly; it is concentrated chiefly in the environs of Benevento, Pontecorvo, and Chiavalle. Little else but the strong tobacco is grown, and the average weight of the crop is 4,500 tons, worth £96,000.

8. *Spain and her Colonies.*—But little tobacco is grown in Spain, while it forms one of the chief industries in her colonies of Cuba and the Philippine Islands, from the first of which the whole world is supplied with the finest leaves. The Havana brands have not their equal in any country, and it is only by very careful treatment and skill in the process of manufacture that we are able in Europe to produce cigars approximating to them in taste and aroma. A certain number of the chief manufacturers of Havana, such as Carvajal, Partagas, Baetz, etc., are represented at the Exhibition, and they are authorized even to sell within the Champ

de Mars specimens of their production. It would, however, be an error to suppose that the whole of the tobacco grown in Cuba is of superior quality. The district called Vuelta-Abajo alone produces the famous brands which are so universally sought after, and the price of which exceeds 6s. or 7s. per pound. The other districts grow only average and common qualities.

The total production of tobacco produced by Cuba is 15,000 tons, of which one-third is grown in the Vuelta district and the remainder is distributed about equally between the Partidos, Remedios, Yare, and Gibaja districts.

As for the Philippine Isles, which produce the well-known Manila tobacco, the Spanish Government, which controls the industry, sells annually to the extent of about £1,600,000, both for internal consumption and exportation.

9. *Russia.*—Tobacco culture in Russia is completely free; it is developed chiefly in the districts of the Saratov, in the Ukraine, Bessarabia, and in the Caucasus. The area under cultivation is about 100,000 acres, and the importance of the crop is such that some 50,000 tons of tobacco are produced annually. Russia exports about one-tenth of her total production, principally the tobaccos of the Ukraine, which are purchased by the Administrations of Austria, Italy, and France, and by the private manufacturers of Germany and other countries. Russia imports large quantities of Turkish tobacco, employed in the manufacture of cigarettes, principally of those so well known under the brand of Laferme.

10. *Sweden.*—A considerable quantity of tobacco is grown in Sweden, and the consumption is large in regard to the population. The first official records on the subject were made in 1780, when there were 72 factories in activity, employing 677 workmen, who produced 236,616 lbs. of smoking tobacco, 997,033 lbs. of chewing tobacco, and 187,769 lbs. of snuff, or a total of 1,371,411 lbs. During the next fifty years only five additional factories were established, while the number of hands was only eighteen more than in 1780. But, on the other hand, the production had more than doubled, and amounted to 2,956,175 lbs. In 1830 the manufacture of cigars was commenced in Sweden and 7,180 lbs. were made. In 1876 there were 100 factories, giving employment to 3,626 workmen. During that year the amount produced was as follows: smoking tobacco, 1,065,000 lbs.; chewing tobacco, 2,023,367 lbs.; snuff, 7,562,153 lbs.; and cigars, 1,377,849 lbs.; being a total of 12,028,428 lbs., and representing a total value of £804,000. The principal factories are situated in Stockholm, Gothenburg, Malmö, and Norrköping; the largest works are those of MM. Helligren & Co., of Stockholm, who produce 10 per cent. of the whole manufacture. Tobacco culture is chiefly developed in the neighborhood of the large towns. As it is not subject to any Government control the total production is not known; in 1870, however, 213 tons were grown around Stockholm, and 128 tons near the town of Kristianstad. The industry was first introduced toward the middle of the 18th century at Åhus, in the district of Kristianstad. At Åhus the average yearly production is about 170 tons. In 1876 there were imported into Sweden 3,400 tons of tobacco chiefly in the form of leaf, but this amount includes also a comparatively small quantity of cigars. The total amount manufactured in the

* One pound Swedish is 997 lb. avoirdupois.

same year was 5,140 tons, so that the difference of 1,740 should represent the quantity of native tobacco which finds its way to the factories. But besides this, a large quantity is dried and treated for home consumption by the provincial population.

11. *Roumania*.—Roumania plants about 5,000 acres, and produces annually about 1,000 tons, consumed entirely within the country.

12. *Turkey in Europe and Asia*.—All the provinces of the Ottoman Empire produce tobacco of very varied qualities. Thus, Thrace, Upper Macedonia, and the districts on the Sea of Marmora furnish only very ordinary qualities; while the rich valleys of Macedonia produce the fine and aromatic tobaccos so highly appreciated among all true connoisseurs. The same remark applies to the Asiatic provinces, where, besides the coarse growths of Smyrna and Ismid, we find the first-class brands of Samsoun and Latakia. It is difficult to estimate exactly the production of Turkey; however, it will be within the mark to give the weight of an average annual crop at 30,000 tons, of which 15,000 tons are grown in Roumelia, 10,000 tons in Anatolia, and 2,000 tons in Syria.

13. *India*.—It is only recently that Indian tobaccos have come in appearance in the European market, where their low price now commands for them a ready sale; and Austria, Germany, France, and Italy purchase considerable quantities for manufacture.

14. *China and Japan*.—It is almost entirely as specimens that Chinese and Japanese tobaccos are found in Europe; certain quantities, however, are sold in England.

15. *United States*.—The United States of North America must be regarded as the great tobacco-growing country of the world. The classes are extremely varied, from the light tobaccos of Maryland, Ohio, Connecticut, and Pennsylvania, to the heavier ones of Kentucky and Virginia. The area under cultivation in 1876 was nearly 550,000 acres, of which about one-third is in the State of Kentucky. The weight of the crop for the same year was 173,000 tons, having a value of £5,640,000. The average production per acre is about 1,300 lbs. for the kinds called seed-leaf, and only about 900 lbs. for the classes called leaf.

16. *South America*.—Among the products of South America, mention must be made of the tobaccos of Varinas, Ambaleña, Carmen, Paraguay, Porto Rico, and St. Domingo; of all of which Germany and England consume large quantities, while the most important are the growths of Brazil and Rio Grande, which find important markets in Bremen and Hamburg. In Brazil the most extended culture is found in the province of Bahia, where from 10,000 to 15,000 tons are grown annually.

Besides the various countries which we have mentioned, there are others of which a brief mention may be made, but where the production is very limited, such as Portugal. This country especially has contributed a very interesting collection to the Exhibition. In conclusion, it will be seen from the figures which have been given in the course of this article that tobacco culture is a source of enormous national wealth, and that the annual production throughout the world cannot be less than 500,000 tons, which represent a value of more than £24,000,000, without taking into consideration the very large quantities of which statistics are not available, especially in those countries where the industry is not subjected to Government supervision.—*Engineering*.

LEWIS SWIFT, THE ASTRONOMER.

THE city of Rochester is honored as the home of a remarkable man, the story of whose life and achievements cannot but interest the readers of the *Evangelist*. He is by no means unknown and unappreciated, and yet he ought to be better known and more highly appreciated. He is emphatically a self-made man, indebted for what he is to no special advantages conferred by others, but to rare natural mental endowments, joined with great powers of endurance, and an indomitable will, that suffers no hindrance to divert him from a course of action once deliberately entered upon. Without the aid of college or university training, or the leisure and facilities that ample means bestow, he has accomplished, unassisted and alone, what very few have with every conceivable circumstance favorable to success. For the encouragement and stimulus his career affords to self-culture, if for no other reason, it should be brought to the attention of the public.

Lewis Swift was born in the town of Clarkson, Monroe county, February 29, 1820. His father was General Lewis Swift, one of the pioneers of Western New York, who moved into that town from New England, in 1809, and became one of the best known and influential men of the region, especially in military circles. The son passed his childhood and youth in his native town. His early life was spent upon a farm, where in all probability he would have continued but for the accidental breaking of a leg, which turned his thoughts to a less laborious employment. For some years he attended the Academy in Clarkson, most of which time it was conducted by that eminent instructor and preacher, Rev. Norris Bull, D. D. From his father he inherited quite a taste for literary and scientific pursuits. At an early age this was greatly strengthened by reading the works of Dr. Thomas Dick, which were so popular thirty or forty years ago. "Celestial Scenery," in particular, had not a little to do in making him an astronomer.

With all the enthusiasm of his earnest nature he entered upon this study, which proved so fascinating to him that he has prosecuted it with constantly increasing zest from that day to this. Every clear, moonless night, for the last twenty years, he has devoted to sweeping the heavens, with his telescope (a four and a half inch refractor), in search of comets! This is his specialty—incessant sky-gazing to find these erratic visitants from far distant worlds. As there is great similarity between them and nebulae (of which some 500 are visible through his telescope, in this latitude), it has been necessary to make himself acquainted with the size, the brightness, and the general appearance of them all, to guard against mistakes as to their identity. Perfect familiarity with every part of the heavens, an unusually retentive memory, and the capacity of nice discrimination, have been indispensable to the successful prosecution of his laborious and exhaustive work.

These nights and years of toil have not been unrewarded. He is the first discoverer of three, and the independent discoverer of two others, i. e., the first in this country, though they had been previously seen in Europe. In 1863 his eye first caught sight of a comet (B), remarkable for brilliancy and length of tail, reaching at one time to 25 degrees. This was of great interest also, as it gave rise to the theory of the identity of shooting stars and comets. He discovered it July 16th; two days later it was seen at Cambridge observa-

tory, and within half an hour after at Dudley observatory; ten days later it was found in Europe.

In 1871 he made his second discovery, but subsequently learned that it had been found eight days previous in Europe. In 1873 he discovered another, quite bright, but clouds prevented his observing it longer than two minutes. He was unable to rediscover it, and it was seen by no one else in any part of the world. It 1874 he was the first American discoverer of the celebrated Coggia comet, which was for a short time supposed to be a new one. As he was the first, so he was the last person in North America who saw it. Its nearness to the sun made it invisible to others, but not to his eye, so thoroughly trained to descry faint telescopic objects. He took his telescope to a height north of the city, and saw it descend beneath the waters of Lake Ontario, never, owing to its peculiar orbit, to revisit our skies again. Only one astronomer north of the Equator saw it later, and he but seventeen hours after, from the clear skies of Italy.

Comet B or (c) of last year was discovered by him three days prior to its discovery in Europe, though for a time it was doubtful whether he would have accorded to him the honor to which he was entitled, Professor Henry having delayed to telegraph the discovery to Vienna. Very likely the delay was caused by the failure in Washington to find it, as Mr. Swift has no instrument for measuring distances, and he was compelled to guess in giving its position; though his modesty led him to ascribe it to the known fact that Rochester has no observatory, and the obscurity of the claimant. He followed the flight of this comet five days longer than any other astronomer in the world.

What is most remarkable is that all Mr. Swift's observations are made under the open heavens, with no protection from the nocturnal blasts of our wintry skies; his observatory being the elevated and slightly flat roof of an extensive cider and vinegar manufactory, about half a mile from his residence. Here every favorable night—and "favorable" means moonless and clear, though the thermometer may indicate twenty degrees below zero, as it sometimes has, and other conditions may be equally unfavorable to comfort—here, for the last six years, he has regularly taken his position, and frequently kept watch until the break of day. When asked how he could endure it thus to spend his nights, and then to give his personal attention to his hardware business during the day, his reply was, "I need very little sleep; can't sleep an hour in the daytime, and I can't bother with sleep when I have clear nights; might just as well be star-gazing as to be rolling and tumbling in the bed."

Mr. Swift moved to Rochester in 1872, from Marathon, Cortland county, where he lived twenty years, there, as here, giving his attention to hardware in the daytime and to comets at night. In 1853 he made him a telescope, and soon after built an observatory with revolving dome, in which the telescope was equatorially mounted. The late Lewis Brooks, Esq., toward the close of his life, became quite interested in Mr. Swift and his devotion to his favorite science. Had he lived Mr. Swift would now have been very differently circumstanced. He had promised him a fine, large telescope, but just as the order was to have been given, he suddenly died. It is understood that the heirs of Mr. Brooks are disposed to carry out his purpose—indeed, to provide a larger and better instrument.

It is hardly conceivable that the public spirited citizens of Rochester will manifest no sympathy with them, to furnish Mr. Swift with the requisite facilities for carrying forward the work for which he is so eminently adapted, and in which he has become so distinguished. The projected observatory will doubtless soon be built by their liberality.

Mr. Swift with all his passion for science is equally a man of affairs. He is as attentive to business as he is devoted to books and the study of nature. The interests of his family are not overlooked in the indulgence of any personal taste. He is something more than a mere star-gazer, being well read in all departments of literature and science, and having kept abreast with the times. As a lecturer upon his favorite science he is very lucid in his statements and explanations; conveys a vast amount of information, in popular and pleasing style, neither weak nor stilted, but appropriate to his sublime theme, and in a manner that imparts something of his own interest and enthusiasm to the hearers. He recently gave an Astronomical Bible Reading, upon a Sabbath evening, in the Brighton church, which strikingly brought out the harmony between the language of inspiration and the latest discoveries of science, and greatly strengthened an intelligent faith in the Word of God. Not to undermine revealed religion, but to establish it, are all his attainments employed. He is confidently commended as worthy of a place in any course of popular lectures.

In 1869 he went to Illinois, one of a party of nine, under the lead of Professor Hough of the Dudley Observatory, and which included President Thomas Hill of Harvard, Professor Murray of Rutgers, and Professor Twining of St. Louis, to observe a total eclipse of the sun, taking with him his telescope, the largest on the ground. The observations were exceedingly satisfactory, and the published report shows that his work was highly appreciated. It is his intention to go to Denver, Colorado, in July (26th), to observe the fourth return of the total eclipse of the sun of 1866. Without his knowledge, he was last Winter elected a member of the "Boston Scientific Society." If high attainments in nearly all departments of knowledge, by the most diligent self-culture and rare devotion to scientific pursuits, united to a generous regard in all things for the highest welfare of the race, entitle one to academic honors, the name of Lewis Swift ought not to remain undistinguished by them, and if honor be rendered to whom honor is due, it will not.—"WYOMING," in the *New York Evangelist*.

LAKE OOROOMIAH.

A NESTORIAN DEACON, KHANAN ESHOO ABRAHAM, writes from Inglesby-house, Stoke Newington-green, N., that having been deputed by the ancient Episcopal Church of the Nestorians to visit this country in order to elicit the sympathy and aid of the English Churches, and having so far attained his object through several interviews courteously accorded to him by the Archbishop of Canterbury, he is further desirous of suggesting to British merchants and capitalists the advantages both to themselves and to the Nestorians of attempts to further develop the commerce of Western Asia. In particular, he suggests the establishment of steamers on the large inland Lake Ooroomiah, which is 100 miles long by 30 broad, and is at present only navigated by dangerous and uncomfortable sailing boats. Several large towns are in the immediate vicinity of the lake, as Tabreez, with a population of 100,000, and Ooroomiah, with 40,000. The present want of communication greatly restricts local commerce. Deacon Abraham further suggests the importance of appointing a British Consul at Tabreez, both for the encouragement of English interests and indirectly as some

protection to the Nestorians and Armenians against Koor-dish persecutions.

NERVE SURGERY.

THIS generation has witnessed a remarkable extension of the domain of practical surgery in the direction of both the magnitude and delicacy of the operations which have been attempted and achieved. The structures which have been regarded as beyond the range of legitimate surgery, which allow of no traumatic interference, the nerves themselves, are no longer to be left in their isolation. Nerve-stretching has been proved to be an operation free from the risks which might reasonably be supposed to attend it. Nerve-suture has been performed, and there are reasons to believe that it may come to be an operation more frequently practiced than it is at present. On this account the careful experimental study of the histological changes which attend and the functional results which follow the union of divided and sutured nerves is of great importance, and we therefore call the attention of our readers to some recent and interesting researches by Dr. T. Gluck which have been made in the Pathological Institute at Berlin, and are published in *Virchow's Archiv*.

The subject has been studied by Eichhorst, especially in the union of minute nerve-branches, but Gluck has preferred to make his observations upon larger nerves, on account of the greater facility for surgical treatment and histological investigation which they present; and his results, which differ somewhat from those of Eichhorst, are of correspondingly greater importance to the surgical pathologist. The nerves selected were the sciatic in the fowl, a creature in which union of a divided nerve occurs with considerable facility; and the vagus in the rabbit, in which, from the tendency to tissue degeneration, nerve-union is much less easy to obtain. These two nerves afford considerable facility for experimental study of the change in their function.

When a nerve is divided the first evident change is that the sheath retracts, and the myelin spreads over the cut surface, while blood is effused into the ends of the nerve and the wound. In a few days the ends of the divided nerve are connected by gray translucent tissue. The further changes depend on the distance between the two ends. The removal of one or two centimeters of nerve prevents all regeneration, even after many months, if the ends are not brought together by artificial means. The nerves and muscles degenerate, the limb wastes, and the fowls die about the fifth month. If, however, the ends of the nerve are carefully sutured together, by preference with catgut, the result is quite different. The closer the approximation and coaptation of the two ends the less is the amount of tissue formed about them, aptly termed "nerve-callus," and the less is the degeneration below. The histological changes which have been found are the following: If a centimeter is removed, the space between the two ends is filled by a soft cellular granulation tissue, containing vessels; the ends of the nerve undergo degeneration. One or two months later only a dense fibrous tissue is to be found in the interval, containing no nervous constituent. Gluck did not in any case succeed in obtaining regeneration when a large piece of the nerve had been removed. If the nerve was simply divided and the ends approximated, the result was very different. In twenty-four hours spindle-cells, arranged in series and surrounded by an abundant intercellular material, lay between the two ends. After eight days the ends were connected together by nerve-fibers destitute of myelin, and from that time there was a gradual formation of the myelin-sheath, the protoplasm becoming darker, and tinting more and more by the action of osmic acid. No degeneration is visible in the central end, except the slight escape of myelin from the divided extremity of the nerve, but in the peripheral end there is a slight indication of degenerative changes. The nuclei of the neurilemma multiply until about the sixth day. The process is thus a union by first intention in the strict sense of the word.

When a piece of a nerve is excised and the ends brought together by sutures, the process is somewhat less simple and less rapid in its course. On the third day the divided ends are connected by soft translucent tissue, in which the catgut sutures are visible, and here and there a little reddish-brown pigment. Microscopically, the two ends are hardly to be distinguished; each presents thrombosis in the minute vessels and a somewhat wavy appearance of the nerve-tubes. In the young granulation-tissue between the ends of the nerves, about the fifth day, peculiar fusiform cells appear, dark, granular, and bearing considerable resemblance to the ganglion cells of the nerve-centers. These appear to connect together the axis cylinders of the divided ends, their continuity with which can be sometimes distinctly traced. The rapidity with which this fusion of the ends of the nerve occurs, determined by the distance of the ends apart, influences the extent of the degeneration in the divided ends. If a nerve is only partially divided, is wounded without complete section of the nerve-sheath, this restoration of continuity is most speedy; it is so, next, when the coaptation of the divided ends is perfect, and when by the eighth or fourteenth day all the nerve-tubes are connected. In such cases the granular or fatty degeneration is slight, and no axis cylinders destitute of myelin are to be seen in the ends of the nerves.

It has been maintained by Eichhorst that in the process of union and restoration a new axis cylinder and medulla are formed by extension from the center toward the periphery, but there is considerable difference between the facts which he and Gluck witnessed. The latter found that a bridge between the two ends was completed at the time at which, according to Eichhorst, the degeneration is at its height and the regeneration is yet far away. Gluck maintains that the axis cylinders do not perish, and that by the fourteenth day, both in the cicatricial tissue and the peripheral end, there are axis cylinders without myelin; but at this period Eichhorst thought the axis cylinders were only beginning to bore through the tissue which separates the ends of the nerves.

The means by which the union of the axis cylinders occurs is believed to be the peculiar fusiform cells, resembling ganglion cells. Near them may be seen young axis cylinders, the nuclei of which bear the closest resemblance to those of the fusiform cells. The processes of these cells are filled with protoplasm, which is at first granular, afterward becomes homogeneous, and ultimately appears to be differentiated into medulla and axis cylinders. The nuclei become paler, and the cellular membrane comes to represent the sheath of the newly-formed nerve-fiber. This method of union is of much interest, as being almost identical with the mode in which, according to the observations of Kölliker, nerve-fibers are formed in the embryo. What, it will be asked, becomes of the catgut ligature during this process?

It is apparently absorbed. In eighty hours the section shows deep excavations in the thread, which increase in size during the next few days, and in about a week all traces of the catgut have disappeared.

During this stage of regeneration of the nerve it is found that its functional power undergoes a restoration closely parallel to that of its structural continuity. Just as no formation of nerve elements is to be traced when a piece of the nerve is cut out, so no restoration of function of the nerve is to be observed under the same circumstances, even after a long time. On the other hand, when the injury is such, as with a needle, that the neurilemma is not divided, functional power is regained in a very brief time. Lastly, when the nerve is completely divided and carefully sutured, it is found that in the most favorable cases functional power is restored in about seventy hours in the case of the sciatic of the fowl, and in about ten days in the case of the vagus of the rabbit. An early restoration of function in divided nerves has been doubted by many pathologists of authority, because, in respect to man, it rests chiefly upon facts as to the early return of sensation, not of motion, in the parts supplied by the divided nerve, and the theory of a collateral path by the peripheral connection with other nerves has seemed a more probable explanation than that of a restoration of function through the injured part. It is, indeed, difficult to exclude the possibility of such an explanation in the experiments upon animals, if the recovery of voluntary power in the muscles at first paralyzed is taken as the indication of the recovery of functional power in the divided nerve. The possibility of such an explanation is excluded,

restored. To test this the left also was divided, and always with the result of causing the death of the animal with the characteristic symptoms of paralysis of both vagi.

A very important practical question in connection with these observations is: How long after complete division can suture be practiced with hope of recovery? An answer to the question is essential for the surgical application of the researches we have described, and this answer is promised at a future time.—*Lancet*.

WILLIAM HARVEY.

A MOVEMENT, supported by a number of eminent medical men, and warmly espoused by public institutions, has recently been made for recognizing the services of Harvey, the discoverer of the circulation of the blood, by erecting a statue of him at Folkestone, his native town. As early as the 1st of April last (the tercentenary of his birthday) as much as £1,100 had been obtained. £500 or £600 are still wanted, and subscriptions will be received at the Western Branch of the Bank of England, Burlington Gardens, W.

William Harvey, born April 1st, 1578, was the son of a yeoman; five of his brothers were prosperous merchants in London, while the sixth was M. P. for Hythe. After being educated at Canterbury Grammar School and Cambridge, Harvey proceeded to the University of Padua, then the most celebrated school of medicine in the world, and obtained there his diploma as Doctor of Medicine in 1602. He then, having obtained a similar degree from Cambridge, settled in London as a physician. In 1609 he was appointed physi-

[Continued from SUPPLEMENT 132.]

THE RELATIONS OF DYSPEPSIAS WITH CONSTITUTIONAL DISEASES.

By DR. J. CORNILLON (of Vichy).

[Translated from *Le Progrès Médical*.]

PART II.

III. *General characteristics of dyspepsias dependent on diatheses and on certain chronic diseases.*—Idiopathic dyspepsias are most often the result of an ill-judged *modus agendi et vivendi*. Moreover, they generally cease rapidly as soon as the ingestion of certain manifestly pernicious articles of food is stopped, when the regimen is modified, and when corporeal exercise is increased. Their slight tenacity and their short duration are their two most salient characteristics. Gastric troubles, symptomatic of a general or chronic disease, have a different aspect. They do not depend exclusively on an individual *modus faciendi*; the alimentation, in whatever respect it may be bad, may be properly corrected, the food rendered more digestible, excitants, of whatever nature, may be suppressed without, by that means, attaining the desired result. This is the reason why I have failed in many attempts with dyspeptic patients who were affected with pulmonary tuberculosis or a cancer of the liver, and why, under other circumstances, I have procured alleviation by attacking directly the diathesis that I suspected to exist, without trying to treat in a special manner the gastric affection for which I was consulted. In congestion of the liver, in biliary lithiasis, I have seen the dyspepsia cease



WILLIAM HARVEY, DISCOVERER OF THE CIRCULATION OF THE BLOOD.

Born April 1, 1578. Died June 3, 1657.

however, by some of Gluck's experiments. Having divided and sutured the sciatic of a fowl, the immediate paralysis of the muscles supplied was found to have passed away at the end of four days. The sciatic was then exposed, divided again above the place of suture, isolated, and laid on a glass plate, as low as the division, into peroneal and tibial nerves. Irritation, mechanical or electrical, of the nerve above the suture, caused contractions in the muscles supplied by it, which must have been due to the conduction of the stimulation through the divided portion. In some other cases evidence of conduction was not obtained until after a somewhat longer period; but at the time at which this power of functional conduction was manifested, histological observation showed that between the two ends of the nerve there was only granulation tissue, or tissue which had not yet assumed the character of nerve-fibers, and we must assume that this suffices to conduct the stimulation.

Other experiments, with a similar result, were made on the vagus. The physiological relation of the two vagi supplies an interesting means of testing the restoration of this function. As is well known, death occurs soon after section of both nerves, while division of one only produces comparatively little effect. The right vagus of a rabbit was divided and sutured with catgut. Ten days afterward the left vagus was divided without the appearance of any of the symptoms which result from the division of both nerves. Hence it was assumed that the function of the left had been

restored. To test this the left also was divided, and always with the result of causing the death of the animal with the characteristic symptoms of paralysis of both vagi. It was during his lecture at this institution that he gradually put forth those views concerning the circulation of the blood which he afterward developed (1628) in his celebrated treatise, entitled "*Exercitatio Anatomica de Motu Cordis et Sanguinis*." Harvey became physician to James I. and Charles I., and in 1636, when he accompanied Lord Arundel in his embassy to the emperor, he publicly demonstrated, in the presence of Professor Hofmann of Nuremberg, his chief opponent, his theory of the movement of the blood, all his hearers being convinced, Hofmann excepted. He was present with the king at the Battle of Edgehill, and took charge of the young princes (afterward Charles II. and James II.) during the flight, sitting with them under a hedge until a cannon-shot plowed up the ground near him and caused him to shift his station. After this he remained at Oxford until that city was surrendered to the Parliament, when he returned to London and lived in retirement, chiefly devoting himself to the welfare and improvement of the College of Physicians. In 1656 he resigned his Lumeleian lectureship, which he had held for more than forty years, and died, worn down by repeated attacks of the gout, on the 3d of June, 1657. The original of our engraving is from a picture by Bemmelt in the collection of Dr. Mead, which picture was engraved by Houbraikin at Amsterdam in 1739, and from this our illustration is copied.

rapidly as soon as that organ had returned to its normal volume, or when the patient had expelled some gravel. Many of our professional friends have, like ourselves, been witnesses of this peculiarity.

A dyspepsia being given, can we diagnosticate the diathesis or the chronic disease on which it depends?—In other words, have symptomatic dyspepsias any decided differential characteristics that will allow us to recognize them at first sight? I do not hesitate to state that their aspect, their progress, alone, does not suffice in every case to establish this distinction. We are often obliged to call to our aid concomitant symptoms, or to find out what there is in the antecedents of the patient, in the influences under which he has been, and what indications are presented, without which facts it will be impossible to make a rational diagnosis. I should add that there are some cases in which such a distinction is possible, and into this subject we will now inquire.

The fact that some diabetic patients are obliged to take an enormous quantity of nourishment to satisfy their hunger is known to everybody. There are some who, not contenting themselves with the meals of the day, arise several times in the night to eat, and if they do not, when away from home, satisfy the exigencies of their stomach, they are seized with distressing twinges in the epigastric region. These unfortunates are obliged to carry constantly with them some liquid or solid food which they can take as soon as their stomach feels empty. It is at this price only that their sufferings

are bearable. It is rare, with this exaggeration of the appetite, for there not to be a depravity of taste; the patients are anxious for sweet and feculent aliments.

Quite frequently, indeed, the insatiable appetite is not at all, as are the polydipsia and the polyuria, a constant and initial sign of diabetes. Often, indeed, we only observe it when the affection is already old, and when it has been badly treated; sometimes it is absolutely wanting. This exaggeration of the appetite coincides ordinarily with emaciation and loss of strength, for it results from the losses sustained by the economy of its elements containing nitrogen and the chlorides. However, the dyspepsia characterized by insatiable appetite may put us on the track of an unrecognized diabetes, without, however, being a positive indication of the existence of this last-mentioned chronic disease; it shows itself, indeed, very often with nervous persons without there being the slightest trace of sugar in their urine. But when the polyphagia is accompanied by thirst, by pronounced emaciation, and by polyuria, we can surely affirm that the patient is glycosuric.

When by itself the dyspepsia is not sufficient to render palpable the constitutional or chronic disease from which it arises, it then produces, in certain cases, nervous troubles which allow us to establish the distinction. With hysterical individuals stomach disorders are the rule; sometimes they are characterized by intractable vomiting, sometimes by an intense gastralgia, and sometimes by a considerable amount of flatulence, accompanied by a swelling of the abdomen from wind. With such a great multiplicity of morbid forms, it will be impossible to assign to the gastric troubles a symptomatic value, if, at the time of the attack, neuropathic symptoms have not come on, which enable us to differentiate them (the dyspeptic troubles) from other disorders of an analogous nature, but not arising from the same pathological origin. Every one knows that at the moment of a seizure there is the ascension of an *aura*, the point of departure of which is the epigastric region, where it gives the sensation of a ball, and from there it goes to the throat. It then produces a distressing dysphagia and a spasm of the glottis, which shows itself by a peculiar wheezing, with the accompaniment of strangulation, palpitations, and syncope. This *aura*, the point of origin of which is the stomach, has been localized by Beau in the pneumogastric nerve, the direction of which it follows from the circumference to the center. When the excitation arrives at the point of emergence of the nerve the convulsions commence, but frequently it does not extend beyond the superior part of the trunk, and then there is no attack, properly speaking. In some cases the *aura* starts from the ovaries, rises to the stomach, joining with the epigastric excitation in such a manner as to constitute a unique *aura* which extends from the pelvis to the larynx. This last origin of the hysterical attack is very frequent, but it does not take away from the dyspepsia its essential characteristics. Therefore every time that a young person of the female sex is attacked by variable digestive troubles, with swelling of the abdomen from wind, the sensation of a ball in the epigastrium, a feeling of strangulation in the throat, intense dyspnea, cardiac palpitations, and syncope, whether or not an attack of frank hysteria declares itself, we should attribute the gastric troubles to this nervous disease.

Of all the diathetic dyspepsias, that of which the characteristics are most clear is without doubt alcoholic dyspepsia. I make a separation of this hybrid form which we meet with in old cachectic drinkers, and which consists sometimes in the vomiting of blood, of alimentary or mucous matters, and sometimes, on the other hand, in an absolute want of appetite or in a distaste for every kind of healthy nourishment. This last variety is, properly speaking, only one of the symptoms of chronic gastritis, with which we have nothing to do in this place. But it is one known under the name of mucous dyspepsia, and is altogether special to chronic alcoholism. It is characterized by the vomiting of glairy or bilious matters, generally occurring after fasting and in the morning at the hour of waking. Moreover, over and above the peculiar nature of the vomiting, which is pathognomonic, the manner in which it takes place is no less special. The act of emesis takes place without the least effort, often without the subject being aware that it is going to occur, and when he is on the point of taking a copious drink. The acts of vomiting do not occur as long as the patient keeps his bed, and while he remains in the horizontal position, taking place only when he puts his foot to the ground; he then has the sense of giddiness in the head, and the evacuations commence. After the attack has passed over the dyspeptic feels easy; he takes up his work without experiencing the least pain in the pit of the stomach or elsewhere; he eats with appetite and digests easily. I have often remarked that when by accident the attacks of vomiting have failed to take place, the patients are unquiet, feel miserable, and complain of cephalalgia. The mucous dyspepsia is a positive index of chronic alcoholism; it is, then, a symptom of very great semeiological value.

The dyspepsia in the arthritic diathesis does not take on such a simple aspect as in the other chronic and diathetic diseases that we have just examined. Sometimes it is characterized by the vomiting of bilious and alimentary matter, coming on at certain hours of the day, and simulating the dyspepsia of alcoholic patients, for which it might be mistaken. It is the same as we observed in the two patients whose very interesting histories we have recounted. Sometimes, on the other hand, it assumes the form of a burning in the tract from the stomach to the mouth, with regurgitation of acid mucus. Finally, it sometimes consists in the belching of gases more or less fetid. These last two varieties of digestive troubles (acid and flatulent dyspepsia) are often united together in arthritis, and it appears to me to be by far most frequent.

I have verified these facts in a very clear manner in a young man of 37 years of age, of good constitution, who at certain times suffered from pains in the knees, the insteps, the metatarsal articulations, with redness and swelling over the articular surfaces. He had remarked that for some time his abdomen swelled after eating, digestion was distressing, and he belched up a great deal of gas, with involuntary expulsion of acid mucus. On the advice of one of his friends he had consulted one of the most celebrated physicians of Paris, who prescribed for him the tincture of nux vomica, and at the end of a month the digestive troubles were considerably ameliorated. When I saw him all the principal symptoms had disappeared; alkaline waters and baths completed the cure.

Many times I have seen these two morbid forms evolve simultaneously in arthritic patients. It is then a valuable sign. But singly and alone they no more have the same symptomatic value, for many people, who are neither gouty nor rheumatic, have at certain times regurgitations of acid mucus. A slight departure from the ordinary method of eating, the drinking of a little very strong liqueur, or a too

copious meal, may suffice to cause these discomforts. I will say this much about flatulent dyspepsia. Although it may appear in a host of chronic diseases, though it may be idiopathic, never is it more pronounced than in hysteria, where it may be regarded as an ordinary symptom of that affection; but when it is accompanied by acidity, it is usually a manifestation of arthritis, moreover if the subject whom it attacks is of the male sex.

M. Pidoux accords to flatulence a symptomatic value greater than I do, for he regards it as an infallible sign of gout, more especially if it is accompanied by painful swelling in the epigastric region, inflation with wind, with cephalic congestion after eating; he attributes to it the origin of dilatation of the stomach occasioned by the too large quantity of food that the gouty person takes.

The progress of dyspepsias, depending either on gout or rheumatism, is even still more characteristic than the morbid symptoms to which they give rise. For, when the attack of gout begins to show itself, the digestive disorders cease, not only during the whole of the duration of the seizure, but even for a long time after it has terminated. There must sometimes even be a slight exciting cause to provoke its return; it exhibits, indeed, a species of derivation similar to that which takes place with the uric acid. Every one knows that during the periods of calm the urine of gouty patients contains more uric acid than is found in the normal state. As soon as the attack declares itself this acid is eliminated in very much less proportion. An active removal is shown which ceases with the attack. In causing the dyspepsia to disappear, the gouty attack exercises on it a manifest influence; but, on the other hand, a reciprocal influence exists. For, as long as the gastric troubles preserve their ordinary intensity, the gouty individuals have little to fear from an attack.

In the rheumatic diathesis we witness the same singular facts. As soon as the muscular, fibrous, articular or other pains come on with a certain degree of vigor the digestive troubles diminish, if they do not cease, and when they are slight or absent, the dyspepsia recommences after a certain time. As in gout, a true displacement shows itself, and the methods of treatment to which we submit rheumatic patients have most often only this aim and this result. Here is an example: This summer I took charge of a patient of 50 years of age, who had experienced in different attacks divers rheumatic manifestations. Five years ago he had sciatica on the left side which kept him in bed a month. Since that time he feels, especially in changes of the weather, vague pains in the limbs, which do not give him any great uneasiness, but, besides this, a flatulent dyspepsia supervened, which has acquired a very considerable intensity during the course of the present year, and has made him morose and melancholic. When I saw him for the first time his appetite was medium, his digestion laborious, and during the whole of the day he was tormented with fetid eructations. He observed to me that since the appearance of this dyspepsia his pains had almost entirely ceased, and that, if he were not so much incommoded by the gas, he would not consent to undergo any treatment, although he ate very little, for he felt much more active, could walk more easily, and had no longer the least pain in the limb which had before been the subject of sciatica.

I advised this patient to drink the water of Vichy at the place itself, and to take a cold bath every day for three weeks. During the whole of the mineral water cure the rheumatic pains were re-established, acquired a very great degree of intensity, and were only soothed a long time after the end of the alkaline treatment. During this period the state of the stomach was considerably ameliorated, the gas had disappeared, and the appetite was satisfactory.

The thermo-mineral cure showed in that patient what is frequently brought about by accident, the displacement of the morbid manifestation. Indeed, as soon as the rheumatic pains had reappeared, the gastric troubles had diminished in intensity; there had been a substitution. Moreover, there often is an alternation, and it was this very alternation that allowed me to pronounce positively in the following case: A patient from St. Etienne was the son of a rheumatic person. He himself has suffered for a very long time from vague pains in the right shoulder and leg and left thigh. Besides, he has experienced certain attacks of neuralgia in the left side of the face, without having any carious teeth. Six years ago he became dyspeptic; every three months during this period he had cramps in the stomach during the night, followed by the expulsion of bilious and alimentary matters; once the attack passed over, the appetite came back, and digestion was easily performed. The patient is sober, and has never been addicted to drink. My embarrassment was great. Had I to deal with an idiopathic or a symptomatic dyspepsia? I hesitated until the moment when he related to me that when he suffered acutely from the stomach the rheumatic pains ceased. From that moment all doubt disappeared; I had to do with a rheumatic dyspepsia.

These morbid displacements are perfectly well known to the laity. Do we not hear daily from rheumatics, when they suffer in the epigastric region, that their rheumatism has gone to the stomach? This opinion has truth in it, for this constitutional disease has the sad privilege of transporting itself indistinctly through all the systems of the economy. Why should it spare the stomach? I do not perceive any reason.

In tubercle and cancer the dyspepsia does not take on a special form as in the constitutional diseases we have just been considering. Sometimes it is characterized by want of appetite and constipation, sometimes by cramps and difficulty in digestion. With some it consists in a feeling of burning and weight in the epigastric region, with others in intractable vomiting. Nothing is more variable. Thus from the aspect and the progress of the affection it is impossible to know whether it is symptomatic or idiopathic. It is into the antecedents of the subject that we should direct our researches. If we have to deal with a steady man, in easy circumstances, never committing excesses in work, there being nothing diathetic in his antecedents, it is very probable that the dyspepsia is idiopathic; but if among his parents tubercles or cancer exist, we should dread sooner or later the generation of one or the other of these grave affections.

In certain cases it is only by exclusion that we can determine whether the stomach troubles depend on a constitutional disease. Troussneau, having had to treat a dyspepsia that rebelled to every kind of treatment, suspected syphilis. After having minutely questioned his patient, he discovered positively that he had previously had venereal symptoms; he prescribed the iodide of potassium, and at the end of a few days the dyspepsia had ceased. This present year I observed a case altogether similar, and obtained an analogous result by the same means.

Unfortunately it sometimes happens that it is difficult to recognize whether a dyspepsia is symptomatic or whether

it is only idiopathic. The subject lost his parents a long time ago, without having the least knowledge of the troubles that affected them; he has neither brothers nor sisters—indeed, nothing by which we can perceive the traces of any hereditary disease whatever. Moreover his mode of living leaves nothing to be desired; he commits no excesses of drinking or otherwise. The duration of the dyspeptic phenomena alone will put us on the track of a diagnosis. If, notwithstanding an appropriate regimen and hygiene, the digestive troubles persist or become aggravated at the end of a month, we certainly have to deal with a symptomatic dyspepsia, for idiopathic dyspepsia does not resist proper treatment for so long a time.

It would, then, only remain to determine whether it does not depend on a diathetic affection, of which it would be one of the pathological manifestations, or whether it should not be connected with a chronic disease of the liver, the kidneys, or some other organ. The increasing progress of digestive troubles, their long duration, the appearance of certain concomitant symptoms alone would permit us to arrive at this diagnostic precision.

A NEW FORM OF FIELD Tourniquet.

By JOHN M. HUNTER, M. D., Staff Surgeon, R. N.

It is, I believe, perfectly novel in design, very portable, and exercises considerable pressure directly on the artery. The accompanying engraving shows its construction and mode of use. It consists of an oval wooden pad $1\frac{1}{2}$ in. by $1\frac{1}{4}$ in.; slightly concave on the lower surface, which is covered with chamois leather. The upper surface is sloped to each side, leaving a flat central ridge, upon which a piece of web (36 inches long), with a buckle, is laid, and fastened by a slip of wood $\frac{3}{4}$ in. high being nailed over it. Two wedges of wood, the breadth of the pad and $1\frac{1}{2}$ in. long, are nailed, with two rows of tacks, upon the upper surface of the web, one on each side of the central slip, the apex of each being about $\frac{1}{4}$ in. distant from it. A square staple, the breadth of the web, made of stout wire, is driven into the base of each wedge, and bent down at right angles so as to project a lit-



tle over the lower edge. The web passes through this staple, which receives the chief strain when in use. A small brass eye is screwed into the center of each base, and then a piece of whipcord fastened to the lower part of one of the eyes and passed once through each eye completes the instrument.

The mode of use is simple. The pad is buckled over the artery, and fixed by one hand, while the free end of the cord is pulled by the other. This causes the wedges to rise from the horizontal position shown by the dotted lines, and assume the upright one indicated by the dark part of the engraving, thus tightening the wedge, and thrusting the pad down on the artery. When the wedges are sufficiently brought together, a couple of half hitches around one of the eyes make it secure. The web being continuous beneath the wedges and central slip, forms a hinge for the apices, keeping them on the pad. The wedges act as levers, and the eyes as pulleys, which, as the cord is threefold, greatly increase the power applied, and the projection of the pad and wedges being all within the periphery of the circle formed by the tightened web, there is no power wasted in mere constriction. The entire instrument weighs a little less than two ounces.—*Lancet*.

PLASTER OF PARIS SPLINTS FOR FRACTURES OF THE LEG.

Abstract of a Clinical Lecture delivered at St. Thomas' Hospital.

By JOHN CROFT, F.R.C.S.

FOR more than two years I have been using at this hospital plaster of Paris splints for all simple and for most compound fractures of the lower extremity. The apparatus consists of—first, inside and outside splints made of common house-flannel and plaster of Paris; and, secondly, of muslin bandages. The splints for fractures below the knee are shaped somewhat like the old short outside splint. The foot-piece is, however, wider. The splint for the inside of the leg is similar in length and width to that for the outside. The splints should be long enough to extend from the tubercle of the tibia to the middle of the metatarsus, and together they should be in width about one inch less than the circumference of the limb at the corresponding part. A rough guide to the shape of the splint may be found in the injured person's stocking when it is laid flat on a table. Each splint is constructed of two layers of the flannel. The outer layer carries the gypsum. The inner layer forms a dry, warm, elastic lining, and protects the skin. These splints are applied by means of the muslin bandages. The bandage is put on like any other, from the toes to the knee. One thickness is enough. Two bandages of five or six yards in length are more convenient than one of ten or twelve yards.

To Make the Splints.—1. A piece of house-flannel or an old thin shrunk blanket, or any suitable substitute, is selected. The pieces may be shaped by measurement, taking the circumference of the limb below the knee, at the biggest part of the calf, just above the ankle-joint, from the front of the ankle-joint round the heel to the front again, and at the middle of the metatarsus. The flannel of each splint should be in width half an inch less than half the circumference at any of those points. The width of the two splints should be one inch less than the circumference of the limb at any corresponding part. It should be long enough to extend from the tubercle of the tibia to the middle of the metatarsus. Four pieces are required—two for each splint. 2. Two bandages of common muslin are prepared, each five to six yards long and two inches and a half in width. 3. About a handful of good dry plaster is mixed with water to the consistency of thick cream. 4. The inside pieces of flannel may be laid on the table or bed, the outer surface being upward. 5. The outside pieces are to be soaked in the plaster separately and laid out on their respective inside pieces.

Application.—While traction is kept up, and the ends of the broken bones are maintained in apposition, the splints are to be applied and smoothed; then the bandage is to be put

on. Traction is to be maintained during the hardening of the plaster. The latter takes place in about three minutes. Next the limb should be laid on a large soft pillow, the toes directed upward, and the knee a little bent. In the application of the bandage great caution should be observed that it is not drawn tightly anywhere, and that no one turn of the bandage is tighter than another. The support is to be equal everywhere. The two splints should not meet by about half an inch either down the front or back. The intervals are spanned by the dry porous muslin; at the sides the bandage is fixed to the splints by the plaster, which cozes into it from the outer layer of flannel. If it become necessary next day, or later, to ease the splints, or to inspect the limb at any spot, the bandage can be slit up with scissors along the middle line in front. One or both of the splints can then be eased from the limb and readjusted by the addition of another bandage. It is undesirable to wholly remove the splints. They are hinged together at the back by the muslin bandage which spans the interval there. The trimming of the apparatus may be done as soon as the plaster shall have hardened. Should the surgeon be short-handed with regard to assistance, he may apply the outside splint first, and lightly bandage that on; and, when that splint has nearly hardened, he may put on the inside one. As swelling subsides, and the splints become more or less loose, an additional bandage should be put on.

At the end of ten days, if the patient is convalescing, the outside bandage may be gummed, or a fresh gummed bandage rolled on. That apparatus will last until splints are no longer needed. At the end of a fortnight, or three weeks, as the case may be, the patient may leave the hospital for his own home.

This mode of treatment is admirably adapted to oblique fractures, accompanied by displacement of the tibia, to cases of Pott's fracture, and to comminuted fractures.

Immediate Use of the Apparatus.—The splints are to be put on when the surgeon is first called to the case. Swelling from contusion and subcutaneous laceration, uncomplicated with lesion of the vascular trunks, is not an objection to the immediate application of the apparatus. On the contrary, the support and enforced rest have a beneficial influence in controlling swelling and its consequent pain.

Covering the Seat of Fracture by Bandage and Splint.—I had never observed that any benefit had been derived from the old practice of leaving those parts exposed. On the contrary, I had thought that the swelling and vesication were aggravated by the omission to support those parts. I have experienced only good results from covering the parts. If the fracture has not been properly reduced, the compression of the skin by the bone and splint will probably cause a slough. My remarks apply to those cases in which the bones have been properly coapted. In these cases the pain is relieved, and the swelling is modified, by the equable support afforded by the splints and bandages. I have not hesitated to resort to them two and five days after the receipt of the injury, when swelling, and, indeed, vesication, had already occurred. I may particularly refer to two cases of Pott's fracture, in which the dislocation had not been thoroughly reduced. Those cases were dressed a week ago to-day, and are now under observation. In one of them the skin over the inner malleolus was already turning black. In the other the leg was swollen, red, and vesicated. The deformities were reduced and the fractures were set while the patients were under the influence of ether, and the plaster splints were fitted on, to the great comfort and welfare of the sufferers. The limbs had been previously treated on Liston's back splint.

I would here insist on the relief and other advantages which ensue when thoroughly equable light support is afforded to a broken limb. It assists to make and it maintains extension, it prevents the recurrence of dislocation, and it obviates the irregular spasmodic muscular movements which occur to an imperfectly supported broken limb. The old short inside and outside splints do not afford these advantages. The limb is unevenly squeezed between the two unyielding concave pieces of wood, or between one splint and a bandage. Similarly, when the limb is bandaged into Liston's back splint, it suffers compression between the two appliances. These splints are also not well adapted to maintain extension.

Plaster of Paris Bandages.—These are capable of insuring all the desiderata, but I do not employ them for the following reasons: First, that an inexperienced bandager may create uneven pressure by drawing one turn of the bandage tighter than another, or by crowding on the bandage and plaster more thickly at one part; secondly, that if the bandage is to be taken off, the whole thickness of the plaster and bandage must be tediously cut through; thirdly, that the bandage must be reapplied as a whole, and the limb therefore subjected to loss of support, remanipulation, and probably resetting.

The lateral splints, hinged together by muslin, present none, or as few as possible, of these risks and disadvantages. The softness and elasticity of the flannel obviate the risk from uneven bandaging, and the span of soft muslin between the front edges of the splints can be easily cut down with ordinary scissors, as I have already pointed out.

The nearest approach to the excellence of these splints is found in what is known as the "Bavarian" splint. It is, however, less easy to maintain efficient extension during the fixation of the latter splint than it is to do so during the same process with regard to the lateral splints; but the more serious objection is in the fact that the "Bavarian" splint must be taken off for the purpose of trimming. That step entails upon the patient remanipulation, perhaps resetting, and its attendant pains.

Starch, Water-glass, Glue, Gummed and Other Fixed Bandages.—These all have the objection that their drying, hardening, or stiffening is a slow process. Plaster of Paris hardens in about three minutes, less or more. Splints of this material possess as much durability as can be required, especially when they have been protected by the addition of a gummed bandage.

When the patient is convalescent, but still needs some support from splints, the side-splints can be taken off and trimmed, eyelet holes can be inserted along the front edges, and the splints can be laid on or removed at will. If the patient be restless, or become the subject of delirium tremens, the fractured limb, secure in its all-but-complete case, may be swung in the ordinary suspensory apparatus, or may even be left free to be jerked about without much, if any, harm. Fractures near the knee-joint, and fractures of any part of the shaft of the femur, have been successfully treated with the aid of this apparatus. The pain just above the heel, which so commonly plagues a patient whose leg has been imbedded in a Liston's back splint, is never complained of by those whose fractures are put up in these plaster splints.

Adaptability to Country and Private Practice.—These splints are characterized by their simplicity, stability, and economy, and therefore commend themselves strongly to the country practitioner. Instead of wooden or metallic splints, which may or may not fit, the surgeon can take out with him, to his case, a bag of plaster of Paris and the muslin bandages, and perhaps the flannel. The plaster, which should be good, but need not be the very best, must be dry, and therefore should be kept, when in store, in a dry warm place. House-flannel does not appear to require "shrinking." The surgeon should be cautious in using any flannel which has not been in some way shrunk. Ordinary new flannel might shrink on the limb and fail to yield to the swelling.—*Lancet*.

CHEMISTRY.

"Note on the Occurrence of Diopside on Chrysocolla from Peru," by CHAS. A. BURGHARDT, Ph.D., of Owens College. A SHORT time ago Mr. W. M. Hutchings, F.C.S., of Birkenhead, sent me some specimens of chrysocolla ($\text{CuSiO}_3 + 2\text{H}_2\text{O}$), from Peru, accompanied with a statement that there were some minute crystals in a cavity in one or two of the specimens which might possibly prove to be the rare mineral diopside ($\text{CaSiO}_3 + \text{H}_2\text{O}$). I proceeded to make a crystallographical and chemical examination of the crystals, and found that although extremely small, the forms could be recognized under the microscope. The chrysocolla mass is eaten into in one or two spots, cavities being produced, which are divided into numerous cells by the intersection of thin partitions of chrysocolla substance. The diopside crystals occur particularly fine in small green tufts and sheaves attached to the partition-walls of the cells, while those crystals clothing the interior of the cells are not so well developed as the others. The measurements so far obtained have not been satisfactory, owing to the extreme smallness of the crystals, but the forms observed are those peculiarly characteristic of diopside, viz., $\alpha\text{P}3-2\text{R}$; the rhombohedron being extremely well defined. No other forms were observed, but a great many fine acicular sub-individuals growing parallel with each other build up a large individual. Some of the crystals I carefully picked out and examined chemically with the following results, viz.: Heated before the blowpipe they were infusible and turned brown, not black, probably owing to one of two causes—either (1) the flame was not a pure oxidizing flame, and a little of the cupric oxide was reduced to cuprous oxide; or (2) there was a slight admixture of quartz with the diopside crystals. The presence of copper was proved by dissolving a crystal in a drop of hydrochloric acid, evaporating off the latter, re-dissolving the residue in a drop of acetic acid and adding potassium ferrocyanide, when the characteristic copper reaction was very marked. There was not the slightest effervescence on dissolving the mineral in hydrochloric acid, but flocculent particles of silica separated out. Mr. Hutchings obtained identical results in a chemical examination of the crystals. From the above tests, the crystallographical examination, and the fine emerald-green color of the crystals, there can scarcely be a doubt that they are really those of diopside. Colorless quartz crystals were also observed associated here and there with the diopside, but $\pm\text{R}$ and $\pm\text{R}$ were both present, generally nearly in equilibrium, and the prism faces exhibited strongly the characteristic horizontal striation; therefore, coupling the marked difference in color and crystal form, a confusion of the two minerals could scarcely be possible.

I believe this is the first instance observed of diopside occurring simultaneously with chrysocolla, and according to my knowledge the first time it has been found in Peru—in fact, out of Russia. The exact locality of the mine cannot unfortunately be ascertained. I am of opinion that the diopside has been formed by the action of water upon the chrysocolla, the latter being a product of the decomposition of cuprite (which is always intimately associated with it) by a solution of silicic acid in water. Very fine botryoidal malachite sometimes occurs associated with chrysocolla and cuprite in the same locality in Peru. I hope shortly to obtain accurate measurements of the diopside crystals.

"On Indigo-blue from Polygonum tinctorium and other Plants," by EDWARD SCHUNCK, Ph.D., F.R.S.

THE author after referring to his investigation of *Isatis tinctoria*, the common woad plant, the results of which were communicated to the Society many years ago (*Memoirs*, 2d series, xii., p. 177, and xiv., p. 181), proceeded to give an account of some experiments he had recently made with *Polygonum tinctorium*, a plant employed by the Chinese for the manufacture of indigo, his object being to ascertain whether the coloring matter is contained in this plant in the same form as in the *Isatis*, viz., as a glucoside. His experiments led to the conclusion that the leaves of *P. tinctorium* contain a substance which cannot be distinguished from the indican of the woad plant. It is amorphous, soluble in water, alcohol, and ether, and by the action of acids is decomposed into indigo-blue and a substance giving the reaction of glucose, probably indiglucone. When its watery solution is boiled or left to stand for some time, it undergoes a complete change, and then no longer yields indigo blue by decomposition with acids, but indigo-red and other products, indican, as formerly shown, undergoing a similar metamorphosis under the same circumstances.

The author recommends for the preparation of this substance the following process: The leaves of the plant having been carefully dried, are ground to powder and extracted with spirits of wine. The green alcoholic extract is evaporated at the ordinary temperature, a current of air being employed to assist evaporation. After evaporation of the alcohol there is left a brown watery liquid, which is filtered from the deposited chlorophyll and fatty matters, and mixed with acetate of lead solution. This gives a copious dirty yellow precipitate, which is filtered off. Basic lead acetate added to the filtrate produces a primrose yellow precipitate, which is filtered off, washed with water, then with alcohol, and then suspended in absolute alcohol. On passing a current of carbonic acid gas through the liquid the precipitate is decomposed, yielding lead carbonate, while the liquid acquires a yellow color. The filtrate is evaporated in a current of air, and water is added to the residue, which it dissolves for the most part. Sulphureted hydrogen is passed through the filtrate to precipitate the lead in solution, and the liquid after filtration is again evaporated. The residue is treated with ether, which leaves a portion undissolved. The ethereal solution leaves on evaporation a yellow amorphous residue having all the properties of indican.

The author made some experiments with the fresh leaves of the plant, from which he concludes that the leaf-cells contain no ready-formed coloring matter with the exception of chlorophyll, and that the indigo-blue which is formed when the vitality of the cells is destroyed by extreme cold, organic lesion, or chemical re-agents is produced by the decomposition of indican, which commences as soon as the protecting influence of the living cell is removed.

It has long been known that some orchidaceous plants, such as *Bletia Tankervillei* and *Callanthe venatrix*, yield indigo-blue. The author examined the leaves of the former plant, and obtained a solution giving the reactions of indican, and he is consequently inclined to suppose that the latter will be found in all cases to be the source from which indigo-blue is derived.

The author mentions a fact which he thinks may be of interest not only to the chemist, but also to the physiologist. On one occasion an alcoholic extract of dried woad leaves, in which the indican had undergone partial decomposition by long standing, yielded on evaporation a quantity of a substance which, when purified, was found to have all the properties of tyrosine. Though it is possible that the tyrosine may have pre-existed in the plant, the author is inclined to think that, like the leucine previously discovered by him, it was a product of decomposition of indican under conditions of which he is at present ignorant, especially as some connection is supposed by chemists to exist between tyrosine and indigo-blue; and on the other hand, tyrosine and leucine so frequently occur together as products of decomposition of protein compounds.

"Note on the Action of Iodine Trichloride upon Carbon Bisulphide," by J. B. HANNA, F.R.S.E., F.C.S.

It is stated by Weber that when iodine trichloride is added to carbon bisulphide a new product is formed. Now I have examined the action of these two substances upon each other, and find it is according to the following equation: $2\text{CS}_2 + 3\text{ICl}_3 = \text{CCl}_4 + \text{CSCl}_2 + 3\text{SCl}_2 + 3\text{I}$.

On adding carbon bisulphide to pure iodine trichloride till it was all decomposed considerable heat was evolved, and on cooling iodine crystallized out. A qualitative examination of the liquid showed the presence of sulphur chloride in large quantities, and on decomposing this with water, the characteristic smell of the sulpho-chloride of carbon was observed. This was further recognized by its deportment with alkalis, and after its removal from the liquid the tetrachloride of carbon was easily recognized by its peculiar sweet smell, strongly reminding one of the smell of primrose leaves.

A weighed portion of the trichloride was heated with the requisite amount of carbon bisulphide to convert it into the above products, when it was found there was neither an excess of carbon bisulphide nor of the trichloride present. The liquid was allowed to cool, and when all the iodine had crystallized out it was passed through a small filter of asbestos, and washed with a few drops of carbon tetrachloride. The iodine on the filter was estimated, and gave only a little under the required amount. The filtrate was then treated with caustic potash, and the separated carbon tetrachloride weighed after transference to a tared bulb. The sulphur in the liquid, left after removal of the tetrachloride of carbon, was oxidized by means of potassium chlorate and strong nitric acid, and estimated as barium sulphate.

The following table gives the figures which were obtained on working with 10 grms. of iodine trichloride, and also those deduced from the above equation:

	Found.	Calculated.
CCl_4	2.05	2.198
SCl_2	1.71	1.641
CS_2Cl_2	2.90	2.890
I.....	5.37	5.438

—Manchester Lit. and Phil. Soc., *Chemical News*.

ELECTRIC DISCHARGE IN TUBES CONTAINING RAREFIED GASES.

By MM. WARREN DE LA RUE and HUGO W. MÜLLER.

THE discharge in a tube of rarefied gas does not differ from that which takes place in air or other gases at the atmospheric pressure. It is not a current in the ordinary sense of the term, but a disruptive discharge, the gaseous molecules effecting a transport of electrification. The gases probably receive two impulses in opposite directions, that from the negative electrode being the more continuous. There are sometimes formed metallic spots upon the tubes, which leave a permanent trace of the intervals comprised between the strata.

SOLUTION OF PLATINUM IN SULPHURIC ACID.

By M. SCHEUER-KESTNER.

IN a former communication (*Comptes Rendus*, lxxxi., p. 892) the author has shown that during the industrial concentration of sulphuric acid in vessels of platinum the quantity of this metal dissolved in acid free from nitrous compounds increases with the concentration of the acid. New experiments undertaken for the purpose of preparing fuming sulphuric acid have induced him to continue his observations. The action upon the metal, so much promoted by concentration beyond 95 per cent., is still further intensified with the concentration of the monohydrated acid. On decomposing sodium bisulphate by heat in earthen retorts lined with platinum, 1 gm. of metal was dissolved for each kilo. of fuming acid produced. The metal is found in a soluble state mixed with the sodium sulphate.

ON VITREOUS MELTED SACCHAROSE.

By H. MORIN.

If heated with water under certain conditions saccharose is transformed into a vitreous product, which preserves its transparency more or less according to the manner of cooling. If this has taken place gradually the product is translucent, but mixed with prismatic crystals. If the cooling is rapid this partial crystallization is avoided. It contains on an average 3.28 per cent. of water, and its sp. gr. at 14° is 1.960.

A NEW METHOD OF PREPARING PROPYL-GLYCOL.

By M. HANRIOT.

THE author employs aceto-brom-hydrine, which is easily prepared by the action of acetyl bromide upon glycerine. The product of the reaction is distilled in a vacuum, and passes over almost entirely about 175° under a pressure of 10 centimeters of mercury. The hydrogenation is conducted in a neutral liquid by means of Dr. Gladstone's coppered zinc, and is completed in about twenty-four hours. The product when hot is mixed with carbonate of potassium in excess, and the paste is exhausted with alcohol. The acetate of propyl-glycol, saponified by an alcoholic solution of potassa, yields isopropyl-glycol.

SCIENTIFIC AMERICAN CHESS RECORD.

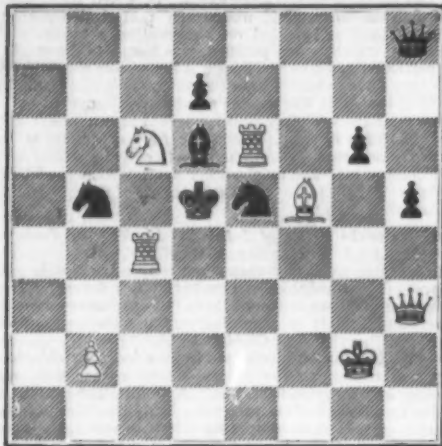
[All contributions intended for this department may be addressed to SAMUEL LOYD, Elizabeth, N. J.]

PROBLEM No. 98.

BY CONRAD BAYER.

First Prize in British Association Tourney, 1867.

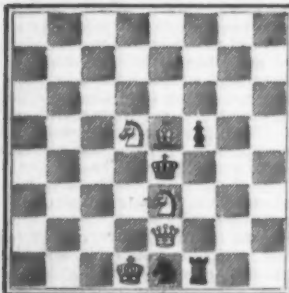
Black.



White.

White to play and mate in four moves.

PIERRE CHARLES FOURNIER DE ST. AMANT.



White to play and mate in four moves.
To the Empire of the Letter Tourney.

In presenting a portrait of St. Amant, we continue the record of such of the famous masters as the chess world has recognized as representative champions of the country in which they reside.

After the death of La Bourdonnais, which occurred in 1841, St. Amant assumed charge of the *Palamede*, the best chess periodical that France has ever produced.

During a visit to London, St. Amant won a few games from Staunton, and which he was always wont to magnify into the importance of a regular match, the result of which was the famous Paris match of 1843, which Staunton won by the decisive victory of 13 to 5.

A return match was spoken of, and Staunton visited Paris for the purpose, but no meeting was arranged; St. Amant and his friends always claiming that the result of the encounters proved a mere equality, as each had won a match.

St. Amant was born Sept. 12, 1800, and died at his Chateau d'Hydra, in Algiers, October 20, 1872.

Aside from the match referred to, we find no record of his having taken part in public matches, and but few specimens of his games have been preserved.

BRITISH CHESS ASSOCIATION TOURNAMENT OF 1867.

This meeting, known as the Congress of Dundee, was held at Dundee in September, 1867. In the grand playing tournament there were ten competitors, each of whom had to contend one game with every other combatant, and the prizes were awarded according to the scores thus made, with the following result:

Herr Neuman won from Messrs. De Vere, Fraser, Blackburne, Hammel, Spens, Robertson and Dr. Fraser, and drew a game with Mr. MacDonnell.—Total, 7½.

Herr Steinitz won from Herr Neuman, Messrs. Robertson, Fraser, Hammel, Spens, MacDonnell, and Dr. Fraser.—Total, 7.

Mr. MacDonnell won from Messrs. Robertson, Fraser, Blackburne, Hammel, Spens, and Dr. Fraser, and drew with Herr Neuman.—Total, 6½.

Mr. De Vere won from Herr Steinitz, Dr. Fraser, and Messrs. Hammel, Robertson, Spens, and MacDonnell, and drew a game with Mr. Fraser.—Total, 6½.

The third prize, therefore, was divided between MacDonnell and De Vere.

We select the game played between the winners of the first and second prizes, which in this particular case, however, resulted in favor of Mr. Steinitz, who only received the second prize.

There was also a tournament for the Scottish championship and a £20 cup, which was won by Dr. Fraser.

There was an interesting handicap tournament, in which there were sixteen entries, the two prizes resulting in a tie between Herr Steinitz and Dr. Fraser, Herr Neuman winning the third position.

A PROBLEM TOURNAMENT.

was also held in connection with the meeting, and the following prizes offered:

For the best set of six problems of from three to five moves, £20; second best, £10; third best, £5; fourth best, £3 10s.; and £10 for the best set by a British composer.

The problems to be original and not previously published, and not to be given for publication without the consent of the managing committee. Each problem to be written plainly on a diagram, with its solution and a distinguishing motto, accompanied by another sealed inclosure containing the name and address of the author.

Non-compliance with the foregoing conditions to entail a forfeiture of the chances of competing.

An award was first made in the summer of 1867, which gave the—

First Prize to Conrad Bayer.
Second Prize to J. Koltz.
Third Prize to J. Kling.
Fourth Prize to L. von Bilow.

And the prize for the best English set to M. Fitzjohn; and we were informed that *honorable mention* was accorded to Mr. S. Loyd. Subsequently it came to the knowledge of the committee that the set receiving the second prize was the joint composition of Messrs. Koltz and Kokeckorn, which being contrary to the intentions of the tournament, the set was disqualified, and Herr Kling received the second prize.

It being found that L. von Bilow had sent in two sets, both were disqualified, and the third prize went to Lieut. Klett, of Stuttgart, and the fourth prize to Herr Landesmann, of Baden. It being further ascertained that the name M. Fitzjohn was an assumed one, the prize for the best English set was awarded to Mr. Grimshaw.

We also received a letter from Mr. Lowenthal informing us that it was found that one of our set had been published, and the set was therefore thrown out of competition. Never having seen any official notice of such a fact, we avoided the blunder that some of the fraternity committed who rushed into print and attacked an award which we most heartily indorse in all of the findings.

The following are selections from the remaining prizes bearing sets:

ENIGMA No. 66.—By P. KLETT.—Third Prize, British Association Tourney.

White.—K on Q 2, Q KR 8, Kt KR 6, B QB 4, Ps K Kt 3 and KR 8.

Black.—K K 4, RK Kt 3, B KR 4, Kt Q R 2, Ps Q R 5, Q 3, Q 8, Q B 3, Q B 6 and Q Kt 5.

White to play and mate in five moves.

ENIGMA No. 67.—By HERR LANDESMANN.—Fourth Prize.

White.—K on KR 7, RQ B 7, Bs KR 2 and Q Kt 7, Kts Q sq and K 6, Ps Q Kt 4, K 2, K Kt 5 and KR 3.

Black.—K K 5, B KR 8, Kts Q R 3, KR sq, Ps QB 5, Q 4 and Q B 7.

White to play and mate in three moves.

ENIGMA No. 68.—By W. GRIMSHAW.—Best British Set.

White.—K on K sq, Q Q B 7, Ra QB 2 and K B 6, Bs K R 6, Kts Q 8 and K Kt 3, Ps Q R 3 and Q B 3.

Black.—K Q 4, Bs K B 5 and KR 2, Kts K sq and KR 4, Ps Q R 2, Q Kt 3, Q 2 and 3, K 5 and K Kt 6.

White to play and mate in four moves.



PIERRE CHARLES FOURNIER DE ST. AMANT.

The following, from our set, has always been considered our best composition:

ENIGMA No. 69.—By SAMUEL LOYD.

White.—K on K B sq, Q KB 6, Bs QB 3 and K Kt 4, P on Q B 6.

Black.—K Q 6, P QB 4.

White to play and mate in four moves.

DUNDEE CHESS CONGRESS OF 1867.

STEINITZ.

NEUMAN.

WHITE.
1. P to K 4
2. Kt to QB 3

BLACK.
1. P to K 4
2. Kt to QB 3

Kt to KB 3 is the defense preferred by most German authors, but the move in the text can be adopted with safety.

3. P to KB 4

Either Kt to KB 3 or B to QB 4, reducing the game to a *Giuoco Piano*, is more preferable.

4. P to Q 4

3. P x P

Although this looks like a slip, it was not made without reflection.

5. K to K 2

4. Q to KR 5 ch

5. P to Q 3

Q to KR 4 ch, followed upon the interposition of white knight, by P to K Kt 4, leads to a strong attack.

6. K Kt to KB 3

6. B to K Kt 5

7. QB x P

7. B x Kt ch

8. K x B

8. K Kt to K 2

Black appears to cramp his pieces upon his left wing by this move.

9. B to K 2

9. Castles

10. Q B to K 3

10. Q to KB 3 ch

11. K to Kt 3

11. P to Q 4

12. B to Kt 4 ch

12. K to Kt sq

13. P to K 5

13. Q to K Kt 3

14. K to B 2

14. P to KR 4

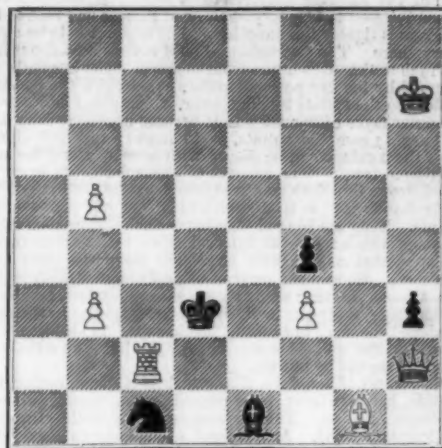
15. B to KR 3

PROBLEM No. 99.

BY HERR KLING.

Second Prize in British Association Tourney, 1867.

Black.



White.

White to play and mate in four moves.

This retreat is judiciously chosen, as the second player's king is kept out of the game for a considerable time.

16. P x P
17. Q to KB 3
18. P x Q
19. Kt to K 2
20. B x Kt

15. P to KB 3
16. Q x KB P ch
17. Q x ch
18. P to K Kt 3
19. Kt to B 4

Well played, to separate the pawns, his own king being nearest to the scene of action. The effect of Mr. Steinitz's fifth move is now visible.

21. P to QB 3
22. B to KB 4
23. KR to K Kt sq
24. R to Kt 7 ch
25. QR to K Kt sq
26. B x B
27. Kt to B 4 ch

20. P x B
21. B to Q 3
22. K to QB sq
23. K to R 3
24. Kt to K 2
25. K to K 3
26. R x B

The maneuvers of the Kt, followed by the advance of the pawns on the queen's side, are finely conceived, as the Kt must decide the action when he reaches Q 7.

28. Kt to Q 3
29. P to Q Kt 3
30. Kt to K 5
31. P to QR 4
32. P to Q Kt 4
33. Kt to Q 7 ch, and black resigns. It is obvious that had he taken one of the pawns, he must have lost the rook just the same.

27. K to B 3
28. R to Q Kt 3
29. KR to R 3
30. QR to Q Kt 4
31. KR to QR 4
32. QR to R 3

SOLUTIONS TO PROBLEMS.

No. 92.—By W. H. ATKINSON.

In giving the solutions to these problems we are pleased to state that our surmises that the above was but an assumed name has been confirmed by a valued correspondent who has discovered that the problem in question is the composition of Mr. G. N. Cheney, and may be found in the *Chess Nuts*, as No. 146, page 87. The five-mover, however, does not appear, but it is well known that many of Mr. Cheney's finest problems were not preserved.

WHITE.

BLACK.

1. B to Kt 2 ch
2. Q to B 7 ch
3. B to K 5 mate.

1. K to Q 3
2. K x Q

2. Q x Kt
3. Q mates.

1. Kt to B 6
2. Any

2. Q to Kt 4 ch
3. Kt to B 4 mate.

1. K to B 5
2. K to K 6

2. B to K 6 ch
3. Mates.

1. K to Q 4
2. Moves

No. 93.—By W. H. ATKINSON.

WHITE.

BLACK.

1. P x Kt P
2. Kt to KB 6
3. P queens
4. B to Q 5
5. Mates.

1. P to Q 7
2. K x Kt
3. Any move
4. Any move

2. P queens
3. Q to Q 8
4. Q to Kt 6 ch
5. Mates.

1. B x B
2. Kt to Kt 4
3. K to Q 5
4. K moves

2. P queens ch
3. Q to Kt sq
4. Q x P ch
5. Kt to B 6 mate.

1. K to K 5
2. Kt to B 3
3. K to B 6
4. K to Kt 5

LETTER "D."—ASSOCIATION LETTER PROBLEM.

WHITE.

BLACK.

1. R to QB 3
2. Kt to Q Kt 5
3. Mate follows.

1. R x R
2. Any move

2. Kt to K 2
3. Mates.

1. P queens
2. Any move

